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GSA Green Building Advisory Committee Advice Letter

Federal Building Decarbonization: Integrated Electrification Solutions

December 4, 2023

Kevin Kampschroer
Chief Sustainability Officer and Federal Director,
Office of Federal High-Performance Green Buildings
U.S. General Services Administration (GSA)

RE: Federal Building Decarbonization: Integrated Electrification Solutions

Dear Mr. Kampschroer:

This letter summarizes the recommendations of the Green Building Advisory Committee (the Committee), based on the third phase of work of its Federal Building Decarbonization Task Group (FBDTG).

Task Group Charter and Scope

As the largest landlord in the US, GSA owns and leases over 363 million square feet of space in 8,397 buildings in more than 2,200 communities nationwide. Of that portfolio, GSA's Public Buildings Service (PBS) owns approximately 1,700 buildings equaling 183 million gross square feet. The energy use of these properties is around 10 billion net BTU.

With facilities in every climate zone, decarbonization and strategic electrification are critical to GSA meeting the requirements of Executive Order 14057 as well as reducing operating costs, extending the useful life of facilities, and improving occupant comfort and wellbeing.

The charter of the GSA Green Building Advisory Committee (GBAC) Federal Building Decarbonization Task Group, in its third phase, was to explore opportunities and challenges for electrification of the federal building portfolio, while aligning with national climate goals, action plans, and legislation. (The first two phases of work of this Task Group were compiled as Advice Letters of the full GBAC to GSA in [April 2022](#) and [November 2022](#).)

The scope of the Task Group was focused on individual buildings, with an emphasis on GSA's core building types: offices, courthouses, and land ports of entry, located across the country. The primary focus of the Task Group was on existing buildings and actions to prioritize the portfolio for retrofit within the next five years.

Task Group Approach

The Task Group completed the following activities in the execution of its work:

- Reviewed current federal policies and executive orders regarding electrification, as a subtopic of focus on building decarbonization.
- Reviewed a wide range of resources from national research labs, non-profit organizations, academic research institutions and the private sector.
- Reviewed GSA's P-100-2021 with 2022 Addendum, *Facilities Standards for the Public Building Service*.
- Hosted guest presentations on electrification by a range of federal, private sector, and non-profit organizations. These included project case studies, electrification frameworks, and related GSA initiatives.
- Reviewed previous Green Building Advisory Committee (GBAC) Task Group activities and Advice Letters.

Presentations to the Task Group included:

- U.S. Department of Energy: Energy Justice
- City of Denver: Building Electrification Program
- Google: Building Electrification
- U.S. Department of Energy Better Buildings Program: Better Climate Challenge
- U.S. Department of Energy Building Technologies Office: HVAC R&D
- GSA: Denver Federal Building 48 Case Study
- Institute for Market Transformation: High-Efficiency HVAC
- GSA: P-100 Federal Facilities Standards
- Buro Happold: Engineering All-Electric Buildings
- GSA: Blanket Purchase Agreements
- GSA: Green Proving Ground (GPG)
- NYSERDA: Empire Building Challenge

Recommendations

Align Agencies and Policies:

Numerous policies impact GSA's direction and approach to developing and maintaining buildings for federal tenants. GSA should work to support alignment and develop synergies among the policies and processes currently underway in order to develop a comprehensive and integrated approach to decarbonization that meets policy requirements, while also supporting agency operations.

- Integrate federal facilities decarbonization strategic planning supported by the Council on Environmental Quality (CEQ) with capital and facilities maintenance planning and use of the climate and economic justice tool.

- Support comprehensive updates to GSA's P100 Facilities Standards that embed decarbonization and electrification of facilities with approaches that will result in achieving federal policy objectives and requirements.
- Collaborate with other federal agencies, including the U.S. Department of Energy's Federal Energy Management Program (FEMP), the U.S. Department of Defense (DOD) and others to develop a common approach and easily accessed set of resources to streamline decarbonization and electrification.
- Bolster the efforts of GSA's Green Proving Ground (GPG) to accelerate technology, equipment, and material innovation and deployment to further achievement of electrification objectives.

Develop a Strategic Electrification Approach:

Considering GSA's complex building typologies and the scale of federal goals for deep energy retrofits (30 percent of facilities) and electrification (100 percent), GSA should consider the operationalization of Strategic Decarbonization approaches that are comprehensive and can occur over time through strategic and effective capital planning and facilities operations and maintenance planning.

Rather than simple one-for-one equipment replacement of fossil fuel burning equipment, Strategic Decarbonization takes incremental steps that make decarbonization technically and economically feasible, significantly reducing loads and managing peaks in electricity demand. The following proposed protocol borrows from other emerging approaches, including the State of New York's [Empire Building Challenge \(EBC\)](#):

1. **Review:** Assess existing building heating and cooling demands, marginal and average grid emissions intensity, utility rate structures, spatial considerations, and available funding resources.
2. **Reduce:** Deploy energy efficiency measures such as envelope improvements, controls optimization, conservation through behavioral change, and ventilation improvements.
3. **Reconfigure:** Convert centralized HVAC systems to lower temperature hydronic distribution, including any necessary conversions at terminal units or air handlers.
4. **Recover:** Recover heat from condenser water, airside exhaust, wastewater or other heat sources such as data centers or thermal networks where compressor-driven heat recovery and thermal storage can maximize these free, available heat sources.
5. **Replace (Initial Electrification):** Consider a range of heat pumps for the remaining thermal load, including air-source, ground-source, and other water-source, segmenting loads, layering heat sources, and/or cascade heat pumps to optimize systems, and solving or deferring decarbonization of peak loads separately as needed due to technical or economic constraints.
6. **Replace (Full Electrification):** Add heat pump capacity, thermal storage, thermal network connections, renewable energy systems and/or grid-interactivity to decarbonize any remaining annual load and to meet or manage outlier peak conditions effectively.

Support Data Tracking and Progress Tracking:

- Develop and institute data tracking and analysis to track progress on electrification efforts.
- Track building performance improvements, emissions reductions, and technology deployment to provide feedback loops on measurable outcomes.
- Develop an approach to review and re-evaluate progress and course-correct when necessary.

In the coming decade, transforming the federal building portfolio will require substantial investment, unprecedented efforts and deployment of numerous new and innovative strategies to achieve federal policy goals and improve building performance and occupant comfort and wellbeing. As one of the most significant facility developers, owners, lessors, and operators in the US, GSA can lead by example and develop comprehensive and integrated approaches to building decarbonization and electrification that can serve as a model and example for others to follow.

Sincerely,

Ralph DiNola, Chair

Green Building Advisory Committee

Fernando Arias, Acting Co-Chair

Green Building Advisory Committee

Roger Chang, Co-Chair

Federal Building Decarbonization Task Group

Donnel Baird, Co-Chair

Federal Building Decarbonization Task Group

Task Group Participants

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GSA Observers

Included representatives of GSA Offices OFHPGB, PBS and OGP.

Public Observers

Included representatives of such organizations as AGA, ASHRAE, AWC, BranchPattern, Greenbank, IDeAS Consulting, IUPAT, LBL, NREL, NYSERDA, PNNL and Wight & Company.

GSA Green Building Advisory Committee Advice Letter

Federal Building Decarbonization: Integrated Electrification Solutions

Background

In December 2021, the White House promulgated [Executive Order \(EO\) 14057](#) mandating that the greenhouse gas emissions of the federal building portfolio be reduced to net zero by 2045. A year later, in December 2022, the White House released the [Federal Building Performance Standard \(BPS\)](#). The purpose of this standard is to significantly reduce Scope 1 greenhouse gas (GHG) emissions – i.e., onsite GHG emissions primarily associated with fuel combustion – from federally-owned buildings.

The Federal BPS requires agencies to cut energy use and electrify equipment and appliances to achieve zero Scope 1 emissions in 30 percent of the building space owned by the Federal government by square footage by 2030. Agencies are encouraged to follow a performance-based approach to electrification, reducing Scope 1 emissions to zero in designated facilities.

Where this is not possible, the Federal BPS provides for a prescriptive option, which specifies technologies (e.g., specific heat pump options to replace gas heating or steam systems) “to implement all practical electrification.” Agencies are required to submit Building Strategic Plans to CEQ to outline how they will meet the BPS.

Consistent with previous recommendations of the Advisory Committee on federal building decarbonization, the standard states: “Agencies should pursue beneficial electrification in the most strategic and cost-effective ways possible, taking portfolio-wide, regional, and campus-wide approaches that maximize efficiencies through multi-building, portfolio planning, and bulk purchasing approaches.”

The Federal BPS defined “practical electrification” for the purposes of the standard as “replacement of fossil fuel consuming systems and equipment with electricity consuming systems and equipment, where practicable, based on (1) cost-effectiveness, (2) market availability, and (3) performance.”

Financing GSA Building Decarbonization

Consistent with the goals of EO 14057 and the Federal BPS, the Inflation Reduction Act (IRA) of 2022 provided significant resources to GSA to help catalyze the decarbonization of the agency’s portfolio. In addition to \$2.15 billion for low embodied carbon materials (a topic not covered here), the IRA provided GSA with \$975 million to support emerging and sustainable technologies and \$250 million for converting GSA facilities into high-performance green buildings.

GSA has also long worked to maximize energy savings performance contracts (ESPCs) as a vehicle for financing deep energy retrofits. GSA's National Deep Energy Retrofit program has produced significant energy and GHG emissions reductions over the past decade and the agency is closely coordinating its IRA investments with its ESPC program in order to dovetail these programs and funding sources. The GSA's decarbonization plan for the [Ronald Reagan Building](#) in Washington, DC represents a pilot demonstration of how to coordinate IRA and ESPC resources to bring a large federal building to net zero GHG emissions.

ESPCs, however require savings to offset the capital investment, which may pose a challenge in any decarbonization effort. For an existing building, decarbonization may require extensive building alterations which will prove challenging to fully fund with savings alone. GSA has recognized this need of additional savings sources, and recently held a special workshop to explore the potential use of these additional savings streams. GSA is encouraged to continue this effort to completion and publication.

Further, ESPCs offer the ability to leverage any capital funds that are held by an agency. Using the savings created by capital spend will augment the ability to decarbonize buildings. A paper by Oak Ridge National Laboratory, [Beyond Guaranteed Savings](#), helps explain this leverage concept. GSA recently announced its plan to use funds made available to link those funds with ESPC to accomplish building decarbonization. GSA is encouraged to promote this effort government-wide.

Another financing and budgetary question is whether the "social cost of carbon" could be incorporated into building project plans as a means to justify longer payback periods or rates of return. On this topic, in September 2023, the White House posted "[FACT SHEET: Biden-Harris Administration Announces New Actions to Reduce Greenhouse Gas Emissions and Combat the Climate Crisis](#)".

This statement includes an announcement that "the President has approved recommendations...on the expanded use of the SC-GHG [Social Cost of Greenhouse Gases] for budgeting, procurement, and other agency decisions, including reaffirming its use for environmental reviews where appropriate." The fact sheet further states: "Agencies should consider procurements of large, durable, energy-consuming products and systems that could serve as pilots for incorporating the SC-GHG. Such pilots will help agencies build the capacity and repeatable methods needed to replicate successes as they more broadly integrate the SC-GHG into federal procurement decisions over time."

The GBAC Federal Building Decarbonization Task Group

During its first phase, the GBAC Federal Building Decarbonization Task Group (FBDTG) primarily focused on accelerating net zero emissions building retrofits, initially across the GSA building portfolio. It developed recommendations on prioritizing buildings for decarbonization retrofits, on project implementation, and on aligning the activities of GSA, the U.S. Department of Energy (DOE) and other teams supporting federal building

decarbonization goals and activities. The resulting [Advice Letter](#) (April 2022) included additional recommendations on how federal agencies can most effectively optimize the decarbonization of their building portfolios – outlining key principles, barriers and opportunities and a proposed Retrofit Playbook approach.

In the second phase of its work, the FBDTG focused on strategies agencies should consider in approaching building portfolio decarbonization, highlighting the use of screening tools to quickly prioritize buildings for decarbonization. The resulting [Advice Letter \(November 2022\)](#) included a proposed building prioritization methodology based on a proof-of-concept spreadsheet tool to screen for decarbonization opportunities across a building portfolio, a proposed building decarbonization project implementation methodology for existing buildings, and a recommended analysis tool to determine standard decarbonization retrofit packages and estimate approximate project costs and impacts for smaller buildings.

Electrification Themes

For the third phase of its work, focused on electrification, the FBDTG identified three key areas of importance:

- Prioritization of electrification scope across the GSA portfolio,
- Design considerations for phasing, and
- Addressing the role of existing and advanced technology.

The committee discussed guidance that could influence two key GSA programs:

- Future revisions to the [P100](#): the Facility Standards for the Public Buildings Services.
- The GSA Center for Emerging Building Technologies' [Green Proving Ground](#), an applied research and deployment program for sustainable building technologies.

Assessing the Portfolio - Decarbonization Assessments and Electrification Audits

Decarbonizing the large and diverse GSA portfolio requires a deliberate strategy for project identification and prioritization to achieve climate goals in accordance with federal cost limits and with maximum cost-effectiveness and positive impact on user health and wellness. Prioritization also informs programmatic and delivery mechanisms.

Considerations for prioritization are described in-depth in Appendix A.

Once priority facilities for retrofit have been identified, GSA will need to conduct decarbonization assessments at such facilities. While the focus of this Advice Letter is on electrification, taking a broader look at the energy and GHG emissions profile of a building and opportunities to reduce load before electrifying will generally enhance project cost-effectiveness and results.

A range of decarbonization strategies can be aligned with available types of funding streams for GSA projects, including for new construction, major repairs and alterations,

and minor repairs and alterations. Taking a holistic, whole building versus component replacement approach brings with it important considerations:

- Benefits:
 - It is easier to financially justify incorporating important improvements other than just replacement of failed equipment, such as energy reduction through envelope upgrades, increased use of daylighting, and application of more efficient mechanical systems.
 - The GSA will typically get better long-term financial results with an integrated holistic solution. In particular, HVAC and electrical systems can be right sized to reduce heating and cooling demands where improvements to ventilation, building enclosure, and lighting happen concurrently. These support not only life cycle costs and reduction of energy use, but also building occupant health and wellbeing.
 - A holistic perspective can be geared to strategically support the White House's [Justice 40 Initiative](#) from Executive Order 14008, i.e., that 40% of the benefits from clean energy investments flow to disadvantaged communities, through the utilization of the Council on Environmental Quality (CEQ) [Climate and Economic Justice Screening Tool](#).

- Challenges:
 - The Office of Management and Budget (OMB) currently budgets for as-needed replacement on an annual basis, which can be a barrier to whole system approaches, outside of large-scale modernization projects.
 - A key part of the decarbonization assessment in buildings that are not already all-electric will be an *electrification audit*. An electrification audit is an evaluation of GHG emissions including on-site fossil fuel combustion and fugitive emissions and utilizing that data to develop a building-level emissions reduction plan.

Utility grid infrastructure that delivers electricity in areas with either a very large GSA building, or a concentration of GSA buildings, may require upgrades if electrification is implemented. This issue is particularly important for GSA buildings located in cold climate areas, as the implementation of building electrification may shift peak loads from summer to winter months.

Electrification Scope Development – The Role of Project Phasing

Electrification Technology

The GBAC underscores and reiterates resources provided in the [Federal Building Performance Standard \(BPS\)](#) issued by White House CEQ in December 2022. The BPS includes appendices of prescriptive measures that provide a distilled taxonomy of technology solutions. These are organized by existing system typology and present recommended decarbonized equipment solutions, along with key considerations for design and procurement.

Table 1 below builds on the tables in those appendices. noting several system types expected to be prevalent in the GSA portfolio, with additional decarbonization solutions and added commentary here from the Advisory Committee.

Table 1 - Paraphrased excerpts from Federal Building Performance Standard, with supporting notes by GBAC (*in italics*).

Pre-Existing System	Decarbonized Systems
Gas-fired packaged rooftop units (RTUs)	Heat pump rooftop units; variable refrigerant flow (VRF); <i>hybrid VRF (VRF with hydronic distribution)</i> ; water-to-air heat pumps.
Low temperature boilers, medium temperature boilers, steam boiler systems.	Air-to-water, water-to-water, ground-source heat pumps; heat recovery chillers; <i>See also Evolving Technology and Strategic Decarbonization sections below.</i>
Air handling units with reheat or perimeter space heating	Assess and convert heat sources; <i>See Boilers item above and Strategic Decarbonization, below.</i>
Campus/district chilled water and steam systems	Transition to low-temperature hot water or heat recovery chillers. <i>See Strategic Decarbonization, below.</i>
Combined Heat and Power (CHP)	Replace gas-fired CHP systems with heat pump solutions, centrally or distributed. <i>See Strategic Decarbonization, below.</i>

This taxonomy can serve to demystify decarbonization within GSA operations and inform guidelines such as the P100 Facilities Standards. It can be particularly useful in guiding component-based building decarbonization efforts at equipment replacement or refurbishment, fit-outs, or other routine asset updates. However even in situations of simple one-for-one equipment swaps, energy efficiency measures, demand management and/or pairing with renewables may be advisable to enable and improve the economics and effectiveness of electrification. See RMI report, [Medium-Size Commercial Retrofits: How to Electrify Mid-Size Office Buildings to Save Energy, Money, and Carbon.](#)

Evolving Technology

The GBAC considers this solution taxonomy to be a snapshot in time and encourages GSA to continually monitor technology state of the market, for example with regard to very high efficiency (VHE) HVAC equipment, cold-climate heat pump performance, higher temperature outputs from heat pumps, and lower global warming potential (GWP) and non-toxic refrigerants.

Heat pumps are not a static technology, but a category rapidly evolving and innovating, from both incumbent and startup manufacturers. In some cases, innovation partnerships or

acquisitions may change the landscape of available technology and application of Buy America provisions. With attention to the nuances of an evolving market, research supported by DOE and the GPG along with the impact of GSA's buying power can accelerate product innovation, technology transfer, and marketization in this category.

Hybrid Interim Solutions

Existing buildings across the GSA portfolio contain a mix of HVAC systems with their individual components having a diverse range of expected remaining lifespans for scheduled replacement. Strategic electrification requires prioritization of how to best replace individual components one by one or perform more comprehensive, holistic systems upgrades.

For buildings in colder climates (ASHRAE climate zone 4+), some projects may consider a short (<5 years) to mid-term (5-10 years) *hybrid interim* solution – in other words blending electric thermal heating systems with fossil fuel heating equipment to handle peak demands, as opposed to aiming for near-term 100% electrification. Such a hybrid approach requires a study of emissions outcomes across the short and long term and recognizes the needs for some projects to break up funding streams. Any full or hybrid electrification solution must focus first on demand reduction and energy efficiency.

Grid-Interactive Efficient Buildings (GEBs)

[Grid-interactive efficient building \(GEB\)](#) technology should be considered integral to electrification for its role in managing building power peaks, supporting the grid's transition to clean energy supply, and achieving the concurrent EO 14057 goal of [24/7 hourly matching](#) of clean electricity. While some GEB technology and functionality is known, it continues to evolve and warrants further study and demonstration, particularly with regard to controls, communication protocols and grid integration. Programs such as DOE's [Connected Communities](#) pilot will shed light on GEB technical solutions, utility interface and value proposition.

Technology Impacts Procurement

Technology considerations will impact procurement pathways for electrification. Unlike conventional energy efficiency such as controls or lighting improvements, electrification today often will not provide annual energy cost savings that provide quick simple payback. Therefore, conventional Energy Savings Performance Contracts (ESPCs) may need to be supplemented with additional funding sources. However, comprehensive projects can combine ESPCs with other funding sources to leverage limited capital and realize deeper decarbonization and more projects. This approach is already being demonstrated by GSA in conjunction with funding received from the Inflation Reduction Act (IRA) – starting with its retrofit of the Reagan Building in Washington, DC – and can be elevated and institutionalized, serving as a model for the whole of GSA and other federal agencies.

User Experience

While this Advice Letter primarily focuses on financing and technical considerations to electrification, these projects can also achieve significant positive impacts on user health

and wellness. The replacement of major system components presents opportunities to improve ventilation air delivery as well as to eliminate the impact of fossil fuel combustion both inside buildings and as a pollutant source within a building's community.

As noted by BOMA's June 2023 study, [Electrification in Commercial Buildings](#), on-site combustion creates air pollution, including methane, nitrogen oxides, carbon monoxide, particulate matter, and other compounds which can be damaging to human health. Heat pumps and induction stoves are a safer option, as handling of gas or liquid fuels is eliminated, as are exhaust systems, which are often challenging to thread through existing buildings.

A March 2023 C40 Cities study, [Why Cities Need to Move Away from Fossil Gas](#) provides a compelling synopsis of financial, health, and community drivers for eliminating the use of fossil gas. It notes that air pollution driven by fossil gas production and consumption caused "35,987 premature deaths in 2020 across C40 cities, 40,326 new cases of asthma in children and 3,317 pre-term births." Notably, the study indicates that a 1.5°C scenario would avoid more than \$3.9 trillion in cumulative health economic losses between 2020 and 2050.

Advisory Committee Recommendations to GSA

Strategic Decarbonization

GSA building types will commonly have more complex, central HVAC systems which may require more comprehensive approaches than simple equipment swaps. [The Reagan Building's decarbonization plan](#) serves as a lighthouse example for such solutions. Notably, the project's comprehensive approach of energy efficiency integrated with electrification is key to managing peak load. Shifting demand peak from cooling to heating season is not expected to increase annual peak magnitude or associated electrical costs.

Considering the complexity of GSA buildings and the scale of federal goals for deep energy retrofits (30 percent of facilities) and electrification (100 percent), GSA may consider operational Strategic Decarbonization approaches. Rather than simple one-for-one equipment replacement, Strategic Decarbonization takes incremental steps that make decarbonization feasible technically and economically, reducing loads and managing peaks. Ideally these incremental steps occur in a planned fashion ahead of emergency replacement scenarios, when comprehensive decarbonization may prove infeasible and/or in conjunction with new fit-outs, occupancy changes or other asset investment triggers.

Examples of this approach are emerging in leading markets and programs such as New York's [Empire Building Challenge](#), also known as Resource Efficient Electrification (REE). There are several steps to the approach, as noted above and listed below, with more detailed recommendations to GSA in the following section:

1. **Review:** Assess existing building heating and cooling demands, marginal and average grid emissions intensity, utility rate structures, spatial considerations, and available funding resources.
2. **Reduce:** Deploy energy efficiency measures such as envelope improvements, controls optimization, conservation through behavioral change, and ventilation improvements.
3. **Reconfigure:** Convert centralized HVAC systems to lower temperature hydronic distribution, including any necessary conversions at terminal units or air handlers.
4. **Recover:** Recover heat from condenser water, airside exhaust, wastewater, or other heat sources such as data centers or thermal networks where compressor-driven heat recovery and thermal storage can maximize these free, available heat sources.
5. **Replace (Initial Electrification):** Consider a range of heat pumps for remaining thermal load, including air-source, ground-source, and other water-source, segmenting loads, layering heat sources, and/or cascade heat pumps to optimize systems, and solving or deferring decarbonization of peak loads separately as needed due to technical or economic constraints.
6. **Replace (Full Electrification):** Add heat pump capacity, thermal storage, thermal network connections, renewable energy systems and/or grid-interactivity to decarbonize any remaining annual load and to meet or manage outlier peak conditions effectively.

Strategic Decarbonization: Detailed Recommendations

- **Review**
 - **Develop a portfolio approach to conducting decarbonization/ electrification audits.** Resources for such audits include Appendix C of the [November 2022 GBAC Advice Letter](#) and the DOE Better Climate [Emissions Reduction Audit Framework](#). This audit should include **development of a database of building characteristics** for existing GSA buildings, including building use, heating and cooling equipment type, building area, demographic location, and climate zone. This data may be drawn from facility condition assessments, but should be organized in a consistent, replicable manner. Reinforce requirements for collection of high-quality, accurate heating and cooling demand data. Consider opportunities to expand required [EISA Section 432 energy audits](#) to include decarbonization opportunities, and follow forthcoming ASHRAE standards that include decarbonization assessments.
 - Coordination with local electric utilities is critical to GSA's success in building electrification and should occur during the programming stage of a project, including **documentation of current and future projected grid emissions factors**. This should integrate work from GSA's carbon-free electricity (CFE) team into the P100.

- **Develop streamlined guidance for GSA to inform design and construction teams on available incentives including the 179D tax deduction, renewable energy investment tax credits and other programs from the Inflation Reduction Act.**
- **Reduce**
 - Evolve the P100 baseline performance tier to further **emphasize and encourage demand reduction measures**, with a focus on integrated solutions that include enclosure upgrades.
 - Focus near-term GSA GPG studies on demand reduction measures, particularly **technologies that are easier to deploy in existing buildings** that may have significant spatial constraints or historic preservation considerations. Such technologies with high impact and low cost should be emphasized, similar to recent studies on [automated air sealing](#).
- **Reconfigure and Recover**
 - Using building characteristic data gathered, identify opportunities to eliminate use of high thermal intensity heating systems, such as steam distribution and higher temperature (>140F) hot water heating systems. **Evolve the P100 framework to emphasize use of lower temperature systems compatible with heat pump systems.** For buildings where distribution system redesign is cost prohibitive, consider heat pumps that can be used to generate 180F water from lower temperature water generated with air-source heat pumps.
 - GSA should **develop targeted electrification phasing guidance by project type**, recognizing that phasing (i.e., strategically transitioning the portfolio to net zero GHG emissions) should give preference to comprehensive upgrades; for example, if an entire building cannot be modernized at once, projects can be aligned with a wing, floor, or tenant space of a building. Key considerations can be found in Appendix A - Prioritization of Electrification Scope.
 - GSA should **develop a strategy for emergency replacement of fossil fuel equipment**, to minimize and possibly avoid like-kind fossil fuel replacements. Utilize 50,000 square feet as a building size threshold for a streamlined electrification and decarbonization pathway.
 - Include the financial benefits of energy cost savings, reduced maintenance and the [social cost of carbon](#) when justifying budget allocations.
 - We encourage the GSA to **work with OMB to study the bundling of funding for a group of buildings**, to allow projects with a high return on investment (ROI) to balance those with a lower ROI, while addressing additional prioritization factors such as equity and resilience. This approach may be justified by the Social Cost of Carbon policy noted above.
- **Store**
 - Continue to build on industry knowledge with grid-interactive efficient buildings, including the role of on-site thermal storage and battery storage, given continuing decreases in price and increases in technology maturity.

Utilize the GPG program to study the impact of small-scale battery storage and low-grade thermal storage on emissions reductions. Such strategies can help limit the impact of electrification on the grid.

- **Replace**

- Demand reduction measures allow replaced equipment to be downsized for better use of capital with improved spatial fit. Given that each GSA building will need a tailored electrification and decarbonization pathway, flexibility is needed. **Develop outcome-based metrics based on GHG emissions intensity** to complement the use of ASHRAE Standard 90.1 performance targets. To assist design teams, grid emissions factor assumptions should be standardized, including an approach to use the assumptions for setting the baseline, interim and final targets. This approach provides flexibility to project teams to explore a range of solutions, including the role of hybrid solutions and continual improvement over time.
- To support life-cycle cost analysis (LCCA), **pre-developed data for teams should be used to account for operations and maintenance costs for electrified systems**. For example, providing design teams with historical energy use/cost information and detailed utility rate structures (e.g., electric demand and other time-of-use/peak use charges). LCCA should include calculation of GHG emissions and explore the impact of a low, medium and high social cost of carbon.
- Utilizing blanket purchase agreements to address electrification of smaller buildings, with an initial focus on small heat pumps (<5 tons) and packaged heat pump roof-top units (<25 tons). GSA is currently employing this strategy to accelerated and simplify purchasing of [electric vehicle supply equipment \(EVSE\)](#). This will further signal to the market the importance of electrification by GSA.

- **Resources**

- The number of groups working on related policy, technology, and standards initiatives is significant. This includes higher education institutions, national research labs, non-profit organizations, federal agencies, and a mix of private sector design, consulting, construction, and real estate development firms. GSA should continue to **invest in high quality education** for staff at all levels, with a priority focus on building operators, design managers, and budget developers involved in selection and costing of equipment and system, and costing.

A consortium of allied organizations focusing on embodied carbon recently announced an initiative to harmonize efforts ([ECHO](#): Embodied Carbon Harmonization and Optimization Project). Given GSA's impact on the real estate industry, it should expand the focus of this **consortium of industry members to electrification** (operational carbon), to drive use of common language and resources, grounded in technical rigor with a focus on implementation.

Next Steps

- In January 2024, the White House and DOE are expected to announce a federal definition of net zero emissions buildings. **GSA should align further electrification roadmap development with this definition.**
- Utilize the GSA's P100 working group to **modify the next edition of the P100 to incorporate guidance from this Advice Letter**, as well as its supporting Appendices.
- Given the rapid development of technology and industry knowledge related to electrification and decarbonization, we recommend GSA **continue to partner with and stay strongly connected to a wide range of allied organizations** (non-profit, academic, local/state government).
- Electrification has strong benefits for communities and public health. In a future workshop or advice letter, we recommend studying the opportunities to further **improve indoor air quality simultaneously with upgrades to decarbonized systems.**

See **Appendices to this Advice Letter** (posted separately at [GSA GBAC website](#)).