Federal Building Decarbonization Agenda

Task Group Overview
• Tim

Sub-team #1 – Key Principles
• Victor

Sub-team #2 – Barriers and Solutions
• Kevin, Fernando, David

Sub-team #3 – Decarbonization Playbook
• Kent, Clay

Task Group Recommendations/Next Steps
• Clay

Discussion
• Tim
Federal Building Decarbonization

Participants

**GBAC Members**
- Clay Nesler – Co-Chair, World Resources Institute
- Timothy Unruh – Co-Chair, NAESCO
- Fernando Arias – Clark Construction
- Nicolas Baker – DOE (designee of Leslie Nicholls)
- Kevin Bates – Sharp Development
- David Kaneda – IdeAs Consulting
- Victor Olgyay – RMI
- Kent Peterson – P2S Engineering
- Jane Rohde – JSR Associates

**GSA Support**
- Kinga Porst Hydras
- Michael Bloom
- Meredith Holland
Federal Building Decarbonization

Participants

**GSA**
- Krystal Brumfield – OGP
- Kevin Kampschroer – OFHPGB
- Michael Bloom – OFHPGB, Designated Federal Officer
- Kinga Porst Hydras – OFHPGB
- Ken Sandler – OFHPGB
- Meredith Holland – OFHPGB (c)
- Lariza Sepulveda – PMA/OFHPGB
- Lance Davis – PCAE
- Sonal Larsen – Office of the Administrator

**GSA OSC**
- Teressa Wykpiwz-Lee
- Drew Jack
- Amy Chiou (Public Engagement)

**DOE**
- Nael Nmair
- Jay Wrobel
Federal Building Decarbonization

Participants

Observers
Cara Carmichael – RMI
Nick Carrillo – Western Wall and Ceiling Contractors Association (WWCC)
Dannie Diionno – Branch Pattern
Ralph DiNola – NBI
Jake Jackson – Pioneer Public Affairs
Greg Johnson – American Wood Council
Laurie Kerr – NYSID
Robert Klugh – Martin Bros & WWCCA
Christopher Lindsay – International Association of Plumbing and Mechanical Officials (IAPMO)
Jeffrey Mang – Policy Consultant
Alexi Miller – NBI
Heather Powen – Martin Bros
Robert Simpson – Signatory Wall and Ceiling Contractors Alliance
Jessica Shipley – Regulatory Assistance Product (RAP)
Ashley Stewart – Steptoe & Johnson
**Charter**

The Federal Building Decarbonization Task Group will explore opportunities and challenges for reducing greenhouse gas emissions - in alignment with national climate goals and action plans - through the use of renewable energy, energy efficiency, electrification and smart building technologies at federal facilities.

**Scope**

Individual buildings, campuses, and supporting infrastructure, including central energy plants, distributed energy resources, and EV charging. Building decarbonization includes operational emissions, refrigerant emissions, and building life cycle emissions, including embodied carbon of materials.

Decarbonization can provide additional benefits such as health, water conservation, grid reliability and resilience. Primary focus will be on existing buildings and actions that can be taken in the short term (3-5 years).
Federal Building Decarbonization

Activities

**Presentations**
- ASHRAE Task Group on Building Decarbonization
- Secretary Granholm at the Better Buildings
- America’s Zero Carbon Action Plan
- NYSERDA Carbon Neutral Building Roadmap
- GSA Decarbonization Strategy and Plans
- National Roadmap for GEBs
- GSA Sustainability Scorecard
- NBI Zero Codes Presentation

**Sub-teams**
- Key Principles for Building Decarbonization
- Barriers and Solutions
- Building Decarbonization Playbook
Key Building Decarbonization Principles

GSA GBAC Decarbonization Task Group

By: Victor Olgyay, Lois Vitt Sale, Cara Carmichael, Laurie Kerr

November 16th, 2021

Table of Contents:
1. Context
2. Purpose
3. Definitions
4. Principles
## Context: Relevant Targets and Executive Orders

<table>
<thead>
<tr>
<th>Most important and relevant</th>
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<tr>
<td>“GSA will lead by example” …</td>
<td>GSA Press Release May 17, 2021</td>
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<td>• “…Federal Building Decarbonization Task Group,….”</td>
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<td>• “…GSA goals of … the elimination of fossil fuel use in newly constructed facilities and facilities undergoing major modernization and achieving net zero emissions by 2030.”</td>
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<td>“Today, the U.S. General Services Administration (GSA) announced its commitment to 100 percent renewable electricity sources for the federal real estate portfolio by 2025…”</td>
<td>GSA Press release, April 22, 2021</td>
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<td>Economy wide targets:</td>
<td>Target announced by Biden, April 22, 2021</td>
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<td>“Today, President Biden will announce a new target for the United States to achieve a 50-52 percent reduction from 2005 levels in economy-wide net greenhouse gas pollution in 2030 – building on progress to-date and by positioning American workers and industry to tackle the climate crisis…”</td>
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<td>“…The United States has set a goal to reach 100 percent carbon pollution-free electricity by 2035…”</td>
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<tr>
<td>“…Environmental Protection Agency Issues Final Rule to Reduce Emissions of Hydrofluorocarbons by 85% over 15 Years…”</td>
<td>The White House Fact Sheet Sept 23, 2021</td>
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Purpose Statement

• To reduce the impacts of climate change and hold to 1.5C increase, we must decarbonize our buildings.

• By implementing visionary decarbonization efforts, GSA will lead by example.

• These principles shape federal decarbonization activities, prioritizing the next 5 years.

• These principles build on the GSA commitment of 100% renewable electricity sources for the federal real estate portfolio by 2025.

• These principles could be used to inform:
  • P100 decarbonization updates
  • Project selection and funding rubrics for GSA and others
  • Decarbonization strategies and planning efforts

• These principles apply to new and existing buildings, across all federal agencies (including DOD) and across all use types
Definitions

There are 2 considerations to building decarbonization – Operational and Embodied.

Operational carbon pertains to carbon emissions from operations, including electricity and gas use, and refrigerants.

Embodied carbon pertains to the carbon emissions from the manufacturing, transportation, installation, maintenance, and disposal of building materials.

Most of our focus is on operational carbon, since the federal building portfolio is almost entirely existing buildings.

What is a Carbon-Neutral Building?

“A carbon neutral building is one where the design, construction, and operations do not contribute to emissions of greenhouse gases that cause climate change.” NYSErDA Carbon Neutral Buildings Roadmap

What is a Zero Carbon-Ready Building?

A Zero-Carbon Ready building is a building that has implemented energy efficiency and has a plan to implement full electrification, demand flexibility and add renewable generation at key trigger events (e.g. equipment replacement or roof replacement) – Refer to RMI/ULI’s Zero Over Time concept paper
The Recipe for Carbon-Free Buildings

Low Embodied Carbon + Efficiency + Electrification + Demand Flexibility + Renewable Energy + Low GWP Refrigerants = carbon free, healthy, resilient buildings

Contextual and Infrastructure Factors

- Industrial emissions (Raw materials extraction, processing, manufacturing and transportation)
- Carbon-Free Mobility (Managed EV charging and Public Transportation)
- Carbon-Free Electric Grid
Federal Building Decarbonization Principles

To decarbonize our federal buildings and cut GHG emissions in half by 2030 to meet Biden administration targets and limit warming to 1.5°C, we must...

1. Accelerate the rate of carbon-free building retrofits.

2. To optimize for cost and impact, plan comprehensively to include efficiency, electrification, demand flexibility and solar/storage. Loading order matters, and varies with location and existing conditions.

3. Maximize the use of onsite renewable generation

4. Include embodied, refrigerant and EV charging emissions.

5. Support resilience, health and comfort.

6. Support system wide optimization to avoid unintended consequences.

7. Support equal opportunity job creation and training underpinned by equitable procurement practices.
1. Accelerate the rate of carbon-free building retrofits.

Retrofit 6% of the federal portfolio each year between 2022 and 2030 to operational zero carbon and operational zero carbon-ready standards to reach 50% reduction by 2030.

*Source: FY 2019 Federal Real Property Profile*
2. To optimize for cost and impact, plan comprehensively to include efficiency, electrification, demand flexibility and solar/storage.

Key Considerations:
1. Loading order matters and varies with location and existing conditions.
2. Improvements should include both capital and operational expenses and savings (and should be lifecycle cost effective, per P100) and include the social cost of carbon.
3. Zero carbon retrofits should coincide with upgrade cycles where possible - each building should have a decarbonization roadmap including vulnerabilities and solutions to align around deferred maintenance and end of equipment life. (e.g. Facilities Conditions Assessments)

1. Maximize onsite renewable production (and storage).
   This includes installing solar on or adjacent to the building or load. It is important since it lowers the demand for electricity at the source, potentially reducing infrastructure for transmission and distribution and associated line losses. Coupling solar with storage enhances the value proposition and solar utilization. Further, if connected to microgrids, they can provide resilience benefits during grid outages. Retain RECs for onsite solar.
   a. Next, consider green power purchasing through your utility.
      Utility scale green power programs, or community solar, are usually generated within the same grid region as the building.
   b. Lastly, consider renewable energy procurement and Bundled Renewable Energy Certificates (RECs).
      Renewable energy procurement, including 24x7 hourly matching strategies which align use with renewable production, play an important and growing role in decarbonizing power systems. However, costs increase significantly for higher levels of load matching and near-term emissions reductions depend on the regional grid mix and how storage resources are operated. * If purchasing renewable energy through a Power Purchase Agreement, retain RECs.

*Source: RMI, 2021 Clean Power by the Hour
1. **Embodied carbon:** Invest in creating a knowledge base.
   a. **Establish baselines:** Assess the embodied carbon of new construction, existing buildings, and renovations in the major types of federal buildings.
   b. **Do pilot projects:** Invest in pilot projects that reduce the embodied carbon of new construction and renovations. Publish results and promote best practices learned.
   c. **Create policies:** Aim to reduce embodied carbon in new construction and renovations by a minimum of 40% below baselines as per the federal building stock or Carbon Leadership Forum data as appropriate, reducing that threshold over time. Extend the lifespan of existing buildings to reduce the need for new buildings.

2. **Refrigerants:** Reduce refrigerant need, use low GWP refrigerants, reduce refrigerant charge, mitigate leakage, and enhance recovery.

3. **Transportation:** Ensure GSA buildings can support EV charging and ensure charging is managed.

4. **Water:** Minimize water use in buildings to reduce treatment and pumping related emissions.

5. Support resilience, health and comfort.

1. Consider incorporating resilience strategies in all buildings at the time of retrofits. Especially by designing to withstand increasing and more extreme weather events, which are the new norm, per IPCC 6th Assessment Report.

2. Thermal comfort should leverage an expanded suite of parameters (beyond just air temperature, but also to include mean radiant temperature, humidity, air velocity, etc.)

3. Ensure 1-2 days of passive survivability (limited mission fulfilment functionality with no active energy input to maintain comfort criteria, per P100. For residences and critical facilities, aim to provide a minimum of two days survivability if the grid goes down.
1. Decarbonization should avoid creating a bigger problem for the grid, subsequently increasing costs for all building owners and occupants. Solutions should account for the regional energy mix.

2. Interventions should be planned proactively, creating a roadmap to a zero-carbon portfolio – don’t do something that will prevent or negate future options.

3. Validate and align building/site decarbonization plans or roadmap based on utility plans.

6. Support system wide optimization to avoid unintended consequences.
7. Support equal opportunity job creation and training underpinned by equitable procurement practices.

1. New building selection should be encouraged in locations where it will bring benefits to the local community, including supporting public transportation.

2. Design, retrofit, procurement, implementation, etc. should support diversity, equity and inclusion.
SUMMARY OF BARRIERS & SOLUTIONS TO DECARBONIZATION FOR EXISTING & NEW BUILDINGS

GSA Advisory Committee - Decarbonization Task Group
Meet the Team:

Kevin Bates
President
Sharp Development Company

Fernando Arias,
Assoc. AIA, LEED AP BD+C
Director of Sustainability
Clark Construction Group

David Kaneda,
PE, FAIA, LEED Fellow
Principal
IDeAs Consulting
Embodied and Operating Carbon:
Building Life Cycle

Why is Embodied Carbon staying the same? Energy efficiency and low-carbon fuels have not yet translated into emissions reductions.

Why is Operating Carbon decreasing? Energy efficient equipment and grid decarbonization policies expected to decrease operational carbon over time.

Image Source: Carbon Leadership Forum, 2020

GSA Green Building Advisory Committee - Decarbonization Task Group - Barriers to Embodied and Operating Carbon Reductions
Appendix to the Primary Barriers & Solutions to Decarbonization for Existing & New Buildings
Barrier: It may be hard to justify appropriations for low economic returns, despite a strong carbon reduction.
Solution: Taking a “portfolio-wide approach” will enable GSA’s high value projects to support those with weaker returns.

Barrier: Banks are underwriting carbon neutral assets the same as conventional designs.
Solution: GSA should advise its private sector landlords to utilize the Appraisal Institutes “Green Addendum” and “Green Registry” to enable them to increase loan dollars to pay for low-carbon improvements.

Barrier: There is currently no income or value stream associated with embodied carbon, as a result appraisers are not giving value to sustainable & low-carbon improvements.
Solution: A Green Bank, similar to an SBA loan guarantee, and Green Bonds could be utilized by GSA’s private sector landlords to help satisfy “First Costs” more cost effectively.

Barrier: There are no baseline metrics to value and budget for the social cost of carbon.
Solution: Quantify embodied carbon and assign a score or grade to a building’s embodied footprint.
Barrier: A shortage of skilled industry professionals that understand how to design, build, and operate lower-carbon existing buildings.
Solution: Establish in-person and virtual trainings to industry professionals in how to design, build, and operate lower-carbon existing buildings.

Barrier: A shortage of non-structural materials for renovations with product-specific EPDs that facilitate carbon accounting for the project.

Barrier: GSA PM staff resistant to adopting lower-carbon materials and management processes.
Solution: Engage senior GSA leadership to establish pilot projects that will persuade broader adoption of key concepts.

Barrier: Subcontractor operating emissions during construction and renovations not easily captured.
Solution: Update the GSA Federal Contractor Climate Action Scorecard metrics to incentivize and/or require subcontractors to track and report operational emissions during construction.
Barrier: Variation in a building’s shape and climate zone, affect the ability to reduce the EUI.
Solution: Use an integrated design approach sensitive to shape and climate zones to minimize EUI. Encourage on-site renewables to further reduce EUI. Publish successful case studies.

Barrier: Lack of local utility-scale renewables/storage in many locations, make carbon emissions reduction challenging. Utility rate differences effect paybacks for on-site renewables/storage.
Solution: Encourage ISO’s to invest in renewables and storage. Where grid emissions factors are above average, utilize efficiency and renewables. Where emission factors are below average, increase focus on efficiency, electrification and energy storage. Provide incentives for renewables and storage.

Barrier: Current building codes often restrict FAR and heights, making on-site renewable installations difficult and these codes rarely address embodied carbon.
Solution: Encourage the use of local “stretch codes” to test decarbonization strategies. Convene building code officials to discuss how to integrate embodied carbon into building codes.

Barrier: Embodied carbon represents a significant amount of carbon emissions in buildings.
Solution: Educate GSA staff on embodied carbon and adaptive building reuse, while using low carbon materials, and designing buildings that last long and can serve multiple uses.
Federal Building Decarbonization

Retrofit Playbook Objectives

• Provide practical guidance for GSA and practitioners to advance federal government building decarbonization goals
• Leverage the work of the key principles and barriers/solutions sub-teams
• Use the 80/20 principle to develop playbooks aligned with critical events in large numbers of existing federal facilities
• Building types:
  o Small buildings with distributed HVAC (<50K ft²)
  o Large buildings with central plant (>50K ft²)

• Project scenarios:
  o Equipment replacement
  o Building envelope repair

• Project scope
  o Building envelope
  o HVAC equipment
  o Building controls
  o Lighting
  o Water
  o Solar energy and storage
  o Demand flexibility
  o Resilience
• Project Development Checklist
  o Specific to building type and project driver
  o Based on the key building decarbonization principles and solutions
  o Considerations for grid emissions, climate zones, energy costs, health and resiliency

• Project Development Process and Tools
  o ESPC ENABLE process (FEMP)
  o Commercial Building Energy Saver Pro (LBNL)
  o Integrated Systems Packages (LBNL)
  o Controller Retuning (PNNL)
  o Healthy Buildings & Energy Support Tool (PNNL)
  o Reopt Lite Tool (NREL)
  o Water Project Screening Tool (FEMP)
1. Take advantage of building envelope repair to improve passive efficiency and incorporate complementary building decarbonization and resiliency measures.

2. Evaluate passive survivability through passive efficiency measures, targeting 48 hours without grid power for critical areas and functions.

3. Estimate reduction in heating and cooling energy use through implementation of passive building envelope measures.

4. Identify additional low-cost, no-cost and short payback energy efficiency measures, and especially those that reduce heating and cooling loads, to further reduce building energy use.

5. Evaluate current equipment load trend data and compare with current equipment capacity to identify opportunities for equipment downsizing.
1. Take advantage of planned HVAC equipment replacements to incorporate complementary building decarbonization/resiliency measures.

2. Evaluate current equipment load trend data and compare with current equipment capacity to identify opportunities for downsizing during replacement.

3. Identify low-cost, no-cost and short payback energy efficiency measures, and especially those impacting heating and cooling loads, to further reduce building energy use.

4. Replace any packaged heating equipment using high efficiency heat pumps - carbon reduction costs favor clean grids and high energy prices.

5. In very cold climate zones, consider using hybrid heating equipment (dual fuel rooftop units) to provide efficient and resilient operation.
6. Replace packaged space cooling equipment with high efficiency, low GWP cooling equipment including variable refrigerant flow (VRF) or packaged rooftop units.

7. Replace fossil fuel water heating with heat pumps or heat recovery chillers and heat pumps.

8. Reduce water consumption to save electricity and heating energy requirements.

9. Install solar photo-voltaic panels on buildings and other on-site structures and grounds, carbon mitigation economics favors dirty electrical grids and high electricity costs.

10. Install energy storage (electric and/or thermal) to provide demand flexibility and increase resilience.
11. Install **EV charging stations** with the ability to provide smart charging and demand flexibility.

12. Install **automated building controls** with the ability to integrate distributed energy resources and EV charging and provide automated demand response and flexibility services.

13. Install **energy sub-metering, energy information management systems** and automated fault detection and diagnostic systems.

14. Maintain **comfortable and healthy indoor environments** through proper air filtration, ventilation and air treatment.

15. Increase **building resiliency** through a combination of passive measures (thermal insulation, day lighting, operable windows and water storage) and backup energy generation and energy storage.
16. Review facility condition indicators to identify any **deferred maintenance projects** which could be integrated into the current project.

17. Estimate energy savings and carbon reductions for all potential improvement measures to determine which deliver the **largest carbon reductions at the lowest cost**.

18. Use **lifecycle cost analysis** to determine the most cost-effective carbon reductions which meet financial return targets.

19. Target projects in **underserved communities**, using local contractors, diverse suppliers and **workers** participating in apprentice programs.

20. Maximize the use of **low-carbon building materials**, and especially the use of reused, remanufactured, recycled and locally-sourced materials.
Federal Building Decarbonization Scorecard

Building Decarbonization Scorecard
1. Passive Efficiency (10 pts)
2. Active Efficiency (10 pts)
3. Controls and Energy Analytics (10 pts)
4. Building Operations (5 pts)
5. Water Conservation (5 pts)
6. Electrification and Renewable Fuels (10 pts)
7. On-site Renewables (10 pts)
8. Off-site Renewables (10 pts)
9. Demand Flexibility (10 pts)
10. Embodied Carbon and Refrigerants (10 pts)
11. Resilience Health and Equity (10 pts)
## Federal Building Decarbonization Scorecard

**1. EFFICIENCY (5 Sections, 40 Points Total):**

### 1.1 Passive Efficiency (10 Points)

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<th>Notes / Observations</th>
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<td>1. Highly insulated</td>
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<td>2. Natural daylighting</td>
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<tr>
<td>3. Natural ventilation</td>
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<td>13%</td>
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<td>4. Green roof or walls</td>
<td></td>
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<td>5. High efficiency windows</td>
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<tr>
<td>6. Effective roof in cooling climate or dark roof in heating climate</td>
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**Score:** 2.5 / 10 Points for section

**Share of section score achieved:** 25%

### 1.2 Active Efficiency (10 Points)

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<td>2. Distributed and Packaged Systems</td>
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<td>3. Thermal Energy Storage</td>
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<tr>
<td>4. LED lighting</td>
<td></td>
<td>13%</td>
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<td></td>
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<td>5. Energy-efficiency lighting</td>
<td></td>
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<tr>
<td>6. Active daylighting</td>
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<td>7. Occupancy-controlled plug loads</td>
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<td>8. Energy star equipment and appliances</td>
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<td>9. Energy star IT equipment</td>
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**Score:** 0.0 / 10 Points for section

**Share of section score achieved:** 0%

### 1.3 Controls and Energy Analytics (10 Points)

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<td>1. Programmable zone thermostats</td>
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<td>2. Basic building automation</td>
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<td>3. Advanced building automation</td>
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<td>4. Energy sub-metering</td>
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<td>5. Energy information systems</td>
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<tr>
<td>6. Smart building and diagnostics</td>
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<td>7. Building optimization</td>
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**Score:** 0.0 / 10 Points for section
1. Incorporate the key decarbonization principles of into **GSA policy and practices**

2. Update **P100 building standards** to drive building decarbonization

3. Complete development of the **building decarbonization scorecard** and test with GSA and other agency staff

4. Develop an approach for **portfolio-level implementation planning**, based on facility-level technical assessments, carbon emissions impact analysis and lifecycle cost/benefit analysis incorporating health, equity and resilience impacts
Federal Building Decarbonization

Next Steps

1. Produce an advice letter summarizing the task group’s activities, key findings, recommendations and next steps

2. Work with GSA staff to incorporate the key principles, solutions and tools into policy and practices

3. Continue the task group with a focus on providing input to GSA on:
   - P100 building standard enhancement
   - Building decarbonization scorecard development and evaluation
   - Decarbonization pilot project selection
   - Portfolio-level decarbonization project prioritization and implementation planning
Federal Building Decarbonization

Questions

1. Should the work of this task group continue?
2. What are the highest priority activities?
3. What other activities should be considered?
4. Other questions?