Note: This proposal is the work of an independent advisory committee to GSA, and as such, may or may not be consistent with current GSA or other Federal Policy. Mention of any product, service or program herein does not constitute endorsement.

GSA Green Building Advisory Committee
Federal Building & Grid Integration: Proposed Roadmap
Advice Letter

December 9, 2019

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

RE: Building and Grid Integration Proposed Roadmap

Dear Mr. Kampschroer:

This letter summarizes recommendations of the Green Building Advisory Committee (the Committee), based on the work of its Building & Grid Integration Task Group, Phase II (Please see list of Task Group members and observers in Appendix A.).

The first phase of the Task Group was charged with "developing policy recommendations to advance grid-integrated federal buildings that leverage technologies and strategies to dynamically shape energy loads, enhancing resilience and providing valuable services to the power grid while saving taxpayer money". It completed its work with the Advisory Committee-approved *Advice Letter and Report: Recommendations for Adoption of Grid-Integrated Building Policy Revisions*, available on the Committee website.

Phase II was tasked with building on Phase I, "to prioritize federal building and grid integration strategies and develop implementation plans and scenarios with future rate structures". In other words, this Task Group was focused on drafting a *proposed roadmap* to aid the federal government in putting Phase I recommendations into practice. This proposed roadmap prioritizes a subset of the Phase I recommendations. While all of the Phase I recommendations should be reviewed and carried out, the proposed roadmap focuses on approaches to carry out the highest priority recommendations.

By setting policies that improve the quality of building-grid integration in federal facilities, GSA and the overall federal government can reap benefits in several ways. Better grid-integrated buildings may unlock lower electric utility bills and save taxpayer money by minimizing demand and capacity charges and allowing the agency to take advantage of time varying pricing (e.g. time of use) rate structures. Federal facilities may increase their own energy security and resilience, as well as the energy security and resilience of the grid itself. And these strategies can help advance a variety of federal energy and environmental goals, including minimizing energy consumption, diversifying energy supplies, minimizing emissions, and maximizing utilization of distributed and renewable generation assets, in a coherent and integrated manner, while supporting the missions of federal agencies.

The Proposed Policy Implementation Roadmap drafted by this Task Group covers the following activity areas:

A. **Building & grid interaction policies for all federal buildings:**
   Review and modify federal energy policy goals, which focus almost exclusively on energy reduction (in percent energy savings and energy use intensity (EUI)), to also include targets pertaining to load management, demand reduction and demand intensity (in kW and W/sf), energy costs, and emissions reduction.
B. **Grid and rate analysis:**
   B-1. Provide essential information about the grid system
   B-2. Provide information on flexible rate structures to facilitate their federal uptake
   Collaborate with utilities and grid operators to analyze the grid system and understand and take advantage of flexible rate structures.[1]
C. **Planning and design for new and existing federal buildings:**

[1] Combines original recommendations C-1 and C-2

Plan and design new buildings and existing building retrofits for grid interactivity.[2]

D. Energy savings performance contracts and utility energy service contracts:

Investigate how Energy Savings Performance Contract (ESPC) and Utility Energy Service Contract (UESC) contracting methods could better incorporate demand savings; consider and pilot promising approaches.

E. Pilot to practice:

Use pilot programs to establish criteria and develop practices to integrate into standard procedure.

Building & grid integration is a rapidly evolving field. New technologies and strategies with the potential to drive new electric supply business models and grid operating paradigms are emerging continually. The GSA is in a unique position, as the largest landlord in the nation, to help shape the future of buildings and the grid, and to harvest a wide variety of financial, security, and environmental benefits in the process. Thank you for your careful consideration of this package and for the opportunity to recommend these findings and recommendations to the GSA. We recognize that these recommendations need to be fully vetted with those agencies and organizations that have a stake in these actions and look forward to working together to further pursue the benefits outlined above. Strong collaboration with other agencies will be a key to success. On behalf of the Green Building Advisory Committee, we respectfully submit this Advice Letter for your consideration.

Sincerely,

Projjal Dutta, Chair
Green Building Advisory Committee

Ralph DiNola, Co-Chair
Building & Grid Integration Task Group

Sonia Punjabi, Co-Chair
Building & Grid Integration Task Group

[2] Includes original recommendation A-2, Plan grid integration improvements over time

Green Building Advisory Committee

Building & Grid Integration: Proposed Roadmap

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Part I: Introduction & Background

Background:

The General Services Administration (GSA) Green Building Advisory Committee voted at its spring 2018 meeting to "develop recommendations on the integration of federal buildings with the electrical grid to enhance resilience, provide savings of both energy and cost, and facilitate distributed energy generation, including renewable sources." The Committee convened a Building & Grid Integration Task Group to investigate this issue and propose recommendations for Committee adoption. After several months of meeting, conferring with experts, conducting research and debating potential policy approaches, this first phase of the Task Group submitted its findings and recommendations to the Committee.

Following debate and comment, the Committee voted to approve the group's report following its September 2018 meeting, with the final version posted as **Advice Letter and Report: Recommendations for Adoption of Grid-Integrated Building Policy Revisions**.

A summary of the policy recommendations for new construction, major renovations, and existing buildings from the initial Task Group is provided below. The six policy recommendations ranked as the highest priorities (those in **boldface** below) were further refined and integrated into a proposed roadmap through the work of the second phase of the Task Group (discussed below):

> **A-1: Modify federal energy goals that focus only on energy reduction (in energy use intensity (EUI), to also include targets pertaining to demand reduction (in kW), load factor, energy costs, and emissions reduction.**
>
> **A-2: Plan grid integration improvements over time**
>
> **A-3: Investigate how ESPC and UESC projects could better incorporate demand savings; consider and pilot promising approaches**
>
> A-4: Incorporate grid integration into building resilience

A-5: Investigate and promote greater use of distributed energy resources and onsite generation

A-6: Investigate, consider and pilot use of energy storage (including “storage-ready” facilities)

B-1: Design for Grid Interactivity

B-2: Design to Zero Energy Buildings (or Zero Energy Ready)

B-3: Incorporate grid integration into Lifecycle Cost Analysis (LCCA)

C-1: Analyze the Grid System

C-2: Understand and Take Advantage of Flexible Rate Structures

C-3: Create incentives for load management transparency

At its September 27, 2018 meeting, the Committee asked the Task Group to reconvene to “build on the recommendations of the first phase of this Task Group, to prioritize federal building and grid integration strategies and develop implementation plans and scenarios with future rate structures.” In other words, the Building & Grid Integration Task Group was asked to focus its Phase II on charting a proposed roadmap to help federal agencies determine how to move forward on implementing the recommendations of the initial Advice Letter, with the following specific next steps:

1. Survey relevant work currently being done on building-grid integration
2. Research existing federal policies into which these recommendations might be integrated and how.
3. Draft a discrete proposed roadmap outlining how to proceed in carrying out this strategy, step by step
4. Develop criteria for selecting pilots
5. Consider mobility and storage challenges and opportunities
6. Continue coordinating with agencies and organizations involved in federal grid integrated buildings efforts

This document will only provide a cursory summary of the previous Advice Letter, which the reader is strongly encouraged to read. This proposed roadmap targets those recommendations determined by the group to be the highest priorities, in order to serve as a starting point for action on the greater integration of federal buildings with the electric grid.

The following Statements of Task Group Mission, Vision and the Problem have not changed from Phase I:

Problem:

The traditionally centralized, one-way electrical grid does not provide the optimal environment for managing many of the new and emerging energy challenges and opportunities of the 21st century. The vision of a smart, two-way grid interacting with smart, responsive buildings provides the promise of fortifying the system to deal with economic, security, supply and demand disruptions while leveraging new opportunities for efficiency, cost savings, resilience and distributed energy generation. Currently, buildings and utilities separately pursue many high-performance energy innovations; however, these efforts are insufficiently integrated to take full advantage of the new range of opportunities. Building owners need to understand the value proposition to integrate their buildings with the needs of the grid. Utilities, operators, and others in the electricity space need to properly value the services that buildings can provide to the grid and align their pricing models with grid health and emissions intensity

Mission:

To advance grid-integrated federal buildings that leverage technologies and strategies to dynamically shape energy loads, help agencies meet their missions, provide resilience and valuable services to the power grid while saving money for the taxpayer.

Vision:

Federal buildings are designed, built, retrofitted, and operated to be smart, connected, and responsive assets that optimize interactions with the power grid in order to achieve agency missions reliably and cost-effectively. These solutions provide a compelling business case for GSA through operational cost savings and increased property value, while also reinforcing national priorities like a more resilient power grid. Fully integrated solutions (i.e., a balanced solution of energy efficiency, distributed energy generation, energy storage, and load flexibility) become standard such that the whole strategy is greater than the sum of the parts.

Benefits & Costs:

The initial Advice Letter had extensive discussion of potential benefits and challenges for federal building-grid integration. This Phase II Advice Letter further incorporates the findings of a more detailed study for GSA by the Rocky Mountain Institute (RMI) of the costs, benefits and potential for grid integration at GSA buildings. The following is a summary of findings and recommendations from the study titled *The Economics of Grid-interactive Efficient Buildings (GEBs) in GSA's Building Portfolio*:

Context and approach:

- RMI was contracted to assess the potential of a grid-interactive efficient building (GEB) strategy, following the original Committee Advice Letter. The GEB concept was originally introduced by the U.S. Department of Energy's Building Technologies Office, to combine building energy efficiency and grid integration goals.
- The report covered measures that address building electric demand: load flexibility, peak load reduction, and demand response. RMI modeled 29 GEB measures across six locations to quantify the potential value of GEBs to the GSA, the federal government, and taxpayers

The Value of GEBs:

- Potential energy impacts: If applied across GSA's owned office portfolio, these measures could generate 165 MW of peak load reduction and 180 GWh/year in annual energy savings.
- Potential economic impacts: Each model shows a simple payback within less than four years. The full portfolio could generate $50 million in annual cost savings (20% of the GSA's annual energy spend) and $184 million in net present value (NPV) over eight years
- Potential to be price-maker: GSA is large and concentrated enough to impact grid-level economics
- Persistent savings: GEB measures enable load flexibility, which may provide savings even as rate structures change

A GSA GEB strategy should prioritize:

- HVAC, lighting, plug load, renewable energy, and storage measures. These are the most cost-effective systems to address.
- Investment in fully controllable systems. For example, many GSA buildings have LEDs, but fully controllable fixtures provide substantial value.
- Staging of large building loads like electric heating, chillers, air handling unit (AHU) fan motors, and plug loads.

Staged loads are an untapped source of demand savings and require little to no new equipment.

- Consistent demand management and peak shaving. Year-round demand management delivers greater value than demand response program participation in most scenarios.
- Battery storage and solar photovoltaics (PV). These technologies make economic sense in most locations, but to varying degrees. Falling first costs make these technologies more important for future projects.

Recommended next steps:

- Fold GEB measures into current projects and pipeline:
  - As GEB measures have short paybacks and high NPVs, the sooner they are implemented, the more value they can capture
    - This makes GEBs valuable for buying down longer-payback measures in ESPC and UESC projects
    - Quick paybacks reduce the risk of uncertainty around future utility pricing, including demand charges
- GEB measures that furnish demand charge savings should be evaluated in all upcoming projects
  - Controllable fixtures and building controls for reducing peak demand should be included in standard specifications, and required when fixtures are changed and/or controls re-programmed
- Develop dedicated GEB pilots to generate proof points:
  - Prioritize locations with high demand rates or time-of-use rates, including New York City ($3.1M NPV, 2.3-year payback) and Fresno ($4.0M NPV, 3.7 year payback)
  - Applying GEB practices to all-electric buildings should be a top priority -- they generate double the NPVs compared to dual-fuel buildings
- Develop and/or adopt a building performance metric that considers electric demand (e.g., load factor)

The value of GEBs will increase over time:

- GEBs could generate up to $70M/year in value to grid users due to reduced generation capacity, transmission and distribution expenses, which could be monetized and benefit all ratepayers. GEBs also improve grid resilience, balance loads, and reduce grid carbon intensity.
- GSA should leverage its size and relationships with utilities and regulators to pioneer opportunities to fully realize this societal value (e.g., by integrating into grid planning) and to monetize where possible (e.g., through new rates and programs)
- Utility rate structures are trending toward higher demand charges, time-varying pricing, and seasonal variation – all of which make GEB projects more lucrative

Part II: Proposed Roadmap

Introduction – Goals and Approach:

The Building & Grid Integration Task Group, Phase II built its proposed roadmap around the top recommendations of the original Advice Letter from Phase 1 – with several of them combined for purposes of the proposed roadmap exercise:

A. **Building & grid interaction policies for all federal buildings:**
   Review and modify federal energy policy goals, which focus almost exclusively on energy reduction (in percent energy savings and energy use intensity (EUI)), to also include targets pertaining to load management, demand reduction and demand intensity (in kW and W/sf), energy costs, and emissions reduction.

B. **Grid and rate analysis:**
   B-1. Provide essential information about the grid system
   B-2. Provide information on flexible rate structures to facilitate federal use of them
   Collaborate with utilities and grid operators to analyze the grid system and understand and take advantage of flexible rate structures.[3]

C. **Planning and design for new and existing federal buildings:**
   Plan and design new buildings and existing building retrofits for grid interactivity.[4]

D. **Energy savings performance contracts and utility energy service contracts:**
   Investigate how ESPC and UESC contracting methods could better incorporate demand savings; consider and pilot promising approaches.

E. **Pilot to practice:**
   Use pilot programs to establish criteria and develop practices to integrate into standard procedure.

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[3] Combines original recommendations C-1 and C-2
[4] Includes original recommendation A-2, Plan grid integration improvements over time

A. Building & grid interaction policies for all federal buildings
Goal
• Review and modify federal energy policy goals, which focus almost exclusively on energy/water reduction (in percent energy/water savings and energy use intensity (EUI)), to also include targets pertaining to load management, demand reduction and demand intensity (in kW and W/sf), energy costs, and emissions reduction. • Reveal the benefits of strategies that reap greater cost savings and grid benefits than energy efficiency alone (e.g., battery storage or thermal storage).
Approach
• Adopt standardized metrics for buildings that include the following considerations to build awareness: ○ Peak demand (gross and normalized by building size, e.g., W/sf). ○ Load factor (i.e., the average electric load divided by the peak load over a specified time period) ○ Energy costs, including demand charges and time-varying pricing (TVP) rate considerations • Design a pathway that optimizes across these metrics.
Proposed Lead Agencies and Roles
• DOE Federal Energy Management Program (FEMP) & Building Technologies Office (BTO) and GSA OFHPB should work together to evaluate the goals, approach and recommended actions/steps proposed here, develop proposed goals and metrics, follow the research steps as appropriate, and garner interagency input via the Interagency Sustainability Working Group. • CEQ should consider developing an executive order on electric grid flexibility and resilience including these goals, for which DOE should develop implementation guidance.
Research Steps
• Review U.S. government's history of energy goals for federal buildings. Review some of the most advanced state and local policies (e.g., California Department of General Services) regarding demand management (including demand response program uptake and use of time-varying pricing (TVP) with load management) in their facilities to help inform the establishment of related federal goals.

Policy Development
• Draft policy defining GSA building-to-grid interaction goals and targets for a pilot program. • Define the process and timeline to analyze pilot programs, determine applicability to other facilities, and transition to implementation ideally at a large set of facilities (though some strategies may be only selectively appropriate – for example, demand response programs are generally only appropriate for facilities with peaks of at least 300-500 kW). At a minimum, the scope should include a large proportion of agency load. • Outline steps to integrate into standards and requirements for federal facility design and operations.
Proposed Implementation Steps
• Review successful federal and non-federal programs integrating demand management, including automated demand response (ADR). • Outline successful steps toward integrating demand-side management and grid interactivity that would be beneficial for federal facilities. • Develop policies and directives on implementing strategies including updates to the Public Buildings Service's P100 Facilities Standards and other relevant criteria. • Identify the impacts such policies and directives have on education and training needs including the identification of new competency requirements in the Federal Buildings Personnel Training Act. • Determine and execute pilot projects to measure results and test viability. • Evaluate results and refine policy measures to apply to relevant federal facilities. • Finalize federal policy.

B. Grid and rate analysis: B-1. Provide Essential Information about the Grid System
Goal
• Develop collaboration among utilities, grid operators and federal agency staff in order to have access to seasonal grid load profiles.

- Analyze grid load profile data and provide information to key federal planners and decision-makers to support understanding of regional grid load profiles and rate structures and facilitate actions (Sections B-2, C, D and E) that optimize federal buildings' engagement with the grid.

Approach

- Prior to implementation of the building-level approaches identified in Sections B-2, C, D and E, relevant agencies should collect and analyze information to support strategy development that helps mitigate capacity, generation and distribution constraints. This investigation should include relevant plans of utilities and Regional Transmission Organizations (RTOs)/Independent System Operators (ISOs). This analysis can be performed to support all federal buildings in a region, rather than on a project by project basis. This information should be regularly updated as systems and rates evolve.
- Use grid data to inform building performance goals:
  - Collect local, regional, and national grid data to identify priorities for building performance and operational response that supports grid operation and reduced operating costs. The data should support a project's use of the most granular data available in the local utility context, but should allow use of default regional data when local data is not available.
  - Grid data includes total (gross) load (usually measured in MW) and net load (typically defined as total load minus variable renewables such as wind and solar), including seasonal variations, defined over a one year period using time increments of one hour, 15 minutes, or 5 minutes. This is used to define system peaks, ramp rates, and other parameters. Associated useful grid-related metrics measured over the same time increments may include marginal carbon emissions, renewable curtailment, cost of delivered energy, distribution and transmission congestion, etc.
  - Data format should be standardized into time-of-use metrics and analysis protocols that can be applied consistently across building project design analysis.
  - Grid data should be updated periodically so that buildings respond to the most current grid conditions in considering design and operational features.
- Identify key time periods where building response would be beneficial to grid operation (including recognition of seasonal differences, e.g., winter vs. summer peaks):

- Deploy load shape analysis of building energy performance in addition to annual energy use metrics to determine building load shape characteristics for comparison to grid-critical time periods. Building response to grid-critical periods should be prioritized in design and operation.
- Operation should be analyzed in the context of cost and rate structure parameters that prioritize grid integration features. GSA may need to negotiate standardized rate structures so that comparisons can be made across the portfolio.
- Time-of-use and rate structure metrics will help define the value of performance flexibility in responding to grid constraints and add resiliency to projects in the context of changing grid characteristics and rate structures.
- Identify specific building infrastructure performance features that will support building-grid integration (and support C below).

Proposed Lead Agencies and Roles

- GSA OFHPB should collaborate with DOE BTO, FEMP, and the Office of Electricity and other partners as necessary, to determine the need to consolidate and/or gather grid operational data per these goals and recommended actions/steps, and follow up as appropriate.
- FEMP should post actionable information in a new public data library tailored for federal customers, with guidance and training on how to use this information.
- GSA PBS Energy Division and the Federal Rate Intervention Workgroup should provide input and develop plans and training to personnel to apply this information to its energy procurement and management.

Research Steps

- Gather contact information for individuals at utilities and grid operators in GSA Regions that can supply needed data.
- Gather information on local, regional and national grid conditions, including national (e.g., FERC) and regional policy goals that impact anticipated rate of change of grid characteristics and priorities. Data and policy requirements should be developed in standardized format for use in building design and evaluation process (Section C below).
- Identify how the data on grid characteristics should be analyzed and applied in the context of portfolios, campuses and individual building projects.

Policy Development

- Develop policies that guide and require grid data be gathered and incorporated into programs and projects along with feedback loops to keep the information up to date and accurate, including:
  - Developing working relationships with utilities and grid operators and gathering grid data for use in policies, programs and projects.
  - Policies and procedures for users of the information to provide feedback to lead agencies on how this information is being used, the benefits derived from its use, and additional information that would be useful.
  - Guidance to agencies with building responsibilities on how to incorporate information (including through the proposed FEMP public data library) into policies, programs and projects.
- Develop metrics that the agencies will be responsible for providing to evaluate program success

Proposed Implementation Steps

- Identify and list the types and sources of information necessary to support development of building-level technical guidance as outlined in Sections B-2 and C.
- Contact appropriate utility and grid operator staff and discuss and make data requests.
- Identify availability of automated demand response and grid-connected appliance technologies as resources for building projects.
- Create an on-line resource for building decision-makers, planners, managers and others to access for local and regional grid information.

B. Grid and rate analysis:

B-2. Provide Information on Flexible Rate Structures to Facilitate Federal Use of Them[5]

Goal

- Understand and take advantage of flexible rate structures.
- Provide information on flexible rate structures to federal agencies and facilitate their use.

[5] Was formerly Goal C-2 in the original Advice Letter.

◦ GSA should align building characteristics and performance (efficiency, storage, distributed generation, and controls or load flexing technologies) and select appropriate rate structures to optimize financial returns.
Approach
• Partnering with utilities and RTO/ISOs, where appropriate, conduct rate analysis and pilot projects in order to promote participation in the most cost-optimal electric rate structures available, ones that usually reflect the variable cost of generating, transmitting, and distributing electricity (e.g., time-of-use, real-time, day-ahead, and critical peak pricing). (Note: Where these time-varying pricing (TVP) structures are not available, it is still often very lucrative for large customers (like many federal sites) to take advantage of load management in order to minimize conventional demand (i.e., monthly peak kW) charges and, in some cases, ISO/RTO capacity charges.) • Identify and install building-level infrastructure necessary to enable load management, including via participation in demand response programs. • Work with local utilities on pilot rate structures to support and incentivize flexible building operation. • Evaluate the potential and opportunity for federal agencies to participate in transactive energy markets – e.g., ancillary services, power sales, and capacity markets. Determine if there are any policies that preclude federal participation in these markets, or if a third party can participate on behalf of federal agencies. • Identify the impacts such policies and directives have on education and training needs including the identification of new competency requirements in the Federal Buildings Personnel Training Act (FBPTA).
Proposed Lead Agencies and Roles
• GSA OFHPB should collaborate with DOE BTO, FEMP, and the Office of Electricity and other partners as necessary, to determine the need to consolidate and/or gather rate structure data per these goals and recommended actions/steps, and follow up as appropriate. • DOE BTO and FEMP, working with the DOE Office of Electricity and other partners as necessary, should gather data on TVP rate structures and demand/capacity charges and periodically update findings • FEMP should post actionable information in a new public data library tailored for federal customers, with guidance and training on how to use this information.

• GSA PBS Energy Division and the Federal Rate Intervention Workgroup should provide input and develop plans and training to personnel to apply this information to its energy procurement and management.
Research Steps
• Review available rate structures (specifically, TVP rates) and available demand response programs, their pros and cons, and current federal uptake relative to what might ensue with an optimized strategy.
Policy Development
• Per Section A, integrate into GSA and FEMP guidance, or an executive order • Guidance should be sensitive to the fact that the strategies that are most worthwhile will vary substantially depending on a) geography, due to utility and ISO/RTO offerings (e.g., some utilities do not sit in any ISO/RTO territory and some don't offer TVP or DR programs) and b) facility load size and flexibility (for example, some labs' scientific experiments can be shifted to off-peak times while others can't). • Accordingly, guidance will likely best be in terms of required or recommended processes for sites to evaluate the key options (e.g., demand and capacity charge minimization, formal DR programs, and TVP), and not necessarily geared towards specific outcomes (besides cost minimization, which will differ depending on the site). • TVP options are one possibility, along with DR programs and conventional demand charge (i.e., monthly peak kW) management, for taking advantage of load management capability. • Incorporate new training requirements into core competencies under the Federal Buildings Personnel Training Act (FBPTA).
Proposed Implementation Steps
• Develop draft guidance that can be used as a template for federal departments or agencies. • Share/vet draft guidance with agencies in order to refine and also to assess uptake feasibility.

C. Planning and design for new and existing federal buildings[6]
Goal
• New buildings and existing building retrofits are planned and designed for grid interactivity

[6] Combines former Goals A-2 and B-1 in the original Advice Letter.

- New buildings and existing building retrofits provide for future load flexibility, responsible grid interactivity and resilience for both buildings and the grid.
- Understand what building characteristics and measures would provide optimal building load profiles corresponding to grid load profiles and support reductions in building demands on the grid.

Approach

- Facilitate the adoption of specific building infrastructure and performance features to support grid integration:
    - Develop protocols for monitoring and tracking of grid-integrated efficient building performance.
    - Develop design guidance and protocols that identify how the data on grid characteristics are to be applied and analyzed in the context of portfolios, campuses and individual building projects, and a technical resource on available technologies and strategies. This guidance will also need to describe specific metrics that the design team is responsible for providing as a mechanism to evaluate program success.
    - Identify automated demand response technologies and grid-connected appliances capable of responding to grid signals that should be specified in projects.
    - Identify technologies and controls associated with on-site storage and grid-connected vehicle charging systems.
    - Develop commissioning and verification protocols to support deployment of grid-integrated technologies at the building level.
    - Develop load flexibility and commissioning requirements to validate and verify grid-integrated building features in response to potential grid signals.
- Identify and deploy building-grid integration technologies and strategies:
    - Building load modification and energy use reduction (passive/permanent building features).
    - Building energy flexibility including smart building controls to better partner with grid.
    - Energy storage to reduce peak demand and grid impact, and maximize the building's ability to use both on-site and grid-delivered renewable energy.
    - Microgrids when applicable to better distribute energy loads and integrate energy storage and renewable generation.
    - Renewable energy including on-site, to the extent possible, and off-site generation.
    - Building-to-grid interaction (utility and third party) – feedback from the grid.

Proposed Lead Agencies and Roles
- GSA, DOE FEMP and BTO should collaborate to determine the need to develop building and grid integration design guidance per these goals and recommended actions/steps, and follow up as appropriate.   - GSA PBS should add key design recommendations to the P-100 Facility Standards.   - FEMP should disseminate and provide training on design recommendations, with the assistance of the Interagency Sustainability Working Group (ISWG), and work with GSA on incorporating core competencies and identified training into FBPTA requirements.
Research Steps
- Define key parameters, and values for those parameters, to set facility design and operational requirements.   - Identify specific pilot sites for implementation of enhanced grid interactivity at both new and existing buildings (former will likely allow greater depth and more elegant solutions, but there are viable retrofits for existing facilities too).   - Undertake pilots and evaluate impacts.   - Document lessons learned through case studies and other output documents.
Policy Development
- Draft policy defining GSA goals and targets for pilot site implementations.   - Define timeline to shift from pilot to full-scale implementation.   - Develop framework for standards and requirements defining facility design and operational requirements.
Proposed Implementation Steps
- Draft standards, requirements and model contract language defining facility design and operational requirements   - Carefully select pilot sites in order to develop reasonable participation targets.   - Enlist targeted pilot sites and evaluate impacts.   - Document lessons learned at pilot sites through case studies and other output documents.   - In case studies documenting pilot sites, document development of quantitative performance parameters and discuss how values for each parameter were defined.

- Develop guidance and training for building operators so that grid integration features of buildings are successfully deployed in the operations phase. This information should include building commissioning protocols that specifically address the capabilities and ongoing operation of grid integration controls and features.
- Develop a standardized building-grid integration analysis protocol that can be integrated into project RFP templates so that design teams bidding on agency work will be made aware of analysis requirements for projects required to meet these policies. This protocol will help design teams understand how building-grid integration measures, strategies, and opportunities should be investigated and analyzed during the project.

D. Energy Savings Performance Contracts and Utility Energy Service Contracts[7]
Goal
• Energy savings performance contracts (ESPCs) and utility energy service contracts (UESCs) incorporate consideration of grid integration benefits including both energy and demand savings. • Prevailing practices and projects (in both these alternatively financed projects and directly funded ones) employ effective demand reduction improvement measures, as well as approaches to including these in project measurement and verification (M&V) and savings guarantees • Demand savings reduce emissions and grid capacity constraints, as well as providing significant savings revenue to most energy projects. • Pilot applications: Implement and document ESPC and UESC projects using promising approaches.
Approach
• Develop and adopt policies to encourage savings from energy demand reduction in ESPC/UESC projects.   • Issue a policy and provide recommendations on taking advantage of demand/capacity charge savings and time varying price rate structures, building on FEMP guidance against using blended rates in ESPCs/UESCs.

[7] Formerly Goal A-3 1 in the original Advice Letter.

- Provide education and training on the benefits and best practices of including demand flexibility measures in ESPC/UESC projects, which should be provided to energy service company (ESCO), utility and federal stakeholders.
- Measure and verify the energy savings while stipulating unit demand and capacity (kW) prices and demand response remuneration rates with an annual escalation factor in ESPC/UESC projects. This can be achieved while still acknowledging and to some extent accommodating (i.e., hedging) their greater volatility, and will encourage longer guarantee periods for these savings, improving the business case for demand flexibility investments.
- Work with state energy offices, utilities and public utility commissions to adopt special tariffs for ESPC/UESC projects that are fixed over a longer period of time or limit their change over time so that estimated energy demand reductions can be incorporated into projects and factored appropriately. Work in conjunction with National Association of State Energy Offices/National Association of Regulatory Utility Commissioners (NASEO/NARUC) grid-interactive building working group convened by DOE BTO.
- Issue guidance on how to factor in demand charges and demand response program payout rates over the contract period to de-risk them, as well as to suggest ways in which agencies and ESCOs can share the risk.

Proposed Lead Agencies and Roles

- GSA and DOE FEMP should collaborate to determine the need to revise the ESPC and UESC programs per these goals and recommended actions/steps, and follow up as appropriate.
- FEMP should develop policy, provide guidance and training to agencies, and revise ESPC/UESC contracts (especially its master indefinite delivery/indefinite quantity (IDIQ) contract) in accordance with the recommendations outlined above.
- GSA's ESPC/UESC Program Management Office should revise its programs per the information and guidance outlined above.

Research Steps

- Interview key stakeholders at BTO, FEMP, national labs, National Association of Energy Service Companies (NAESCO), and ESCOs to understand the current situation.
- Document best practices and provide policy guidance for federal ESPC/UESCUESC projects.
- Key findings of research initiated by the Task Group include the following**:**

- Demand reductions can generally be included in ESPC/UESC projects and counted towards energy savings goals, but usually are not. Preliminary analysis suggests demand savings are more prevalent in UESCs (perhaps because utilities are more aware of the value, and beneficiaries of it).
- Rate structures matter. Cost savings due to time-of-use (TOU) rates in which rates change during the day at predictable times and amounts (with usually a peak, off peak, and two shoulder periods) are fairly tractable for ESCOs to assess savings; actual TOU rates (not average or blended ones) should be included in savings guarantees and business cases. The savings from time-varying pricing (TVP) rate structures with dynamic pricing (such as real-time, day-ahead, and block-and-index pricing) are harder to assess and can require simplifying assumptions and significant "guesstimating."
- The use of blended electricity rates underestimates the value of demand flexibility – consistent with FEMP guidance, using blended rates to calculate savings is discouraged.
- In rare instances, federal procurement managers haven't allowed cost savings from demand management in ESPCs but there is no specific GSA, DOE, or DOD policy or guideline prohibiting it, even though the group did not identify specific guidance encouraging it. The DOE ESPC rule (10 CFR 436 Subpart B) implies the acceptability of this practice in the way it defines savings. Agencies will need training and education, and perhaps policy, to explicitly encourage demand savings.
- Demand reduction savings estimates are usually discounted (by up to 50%) in savings guarantees to be conservative (implying dubious confidence about their realization).
- The expertise required to identify, quantify and engineer demand reduction measures is specialized and not widely distributed through ESCOs and federal agencies and presents greater risk to ESCOs since demand management is time-sensitive and requires some degree of ongoing attention (if not intervention). Unless the ESCO is managing the controls and potentially operations and maintenance (O&M), there may be greater risk. In this instance, some form of risk-sharing with the agency is likely warranted to keep both parties motivated.
- The savings from demand response (DR, usually capacity) program participation, in the rare instances where DR is present at all in ESPCs, are generally only guaranteed and included in the business case for a few years (three years is most common) because DR programs' remuneration rates ($/kW) can change and are only known for this period into the future (due to capacity auctions only having a three-year look-ahead). This is still helpful as there is more risk of a savings shortfall in the first years of a

contract. Savings are sometimes tracked and reported for the entire contract period, although not guaranteed. Directing these additional savings to a project-based reserve fund for specific improvement measures could be evaluated as a potential way to provide incremental investment and benefits over the term of a project. ○ Demand response programs that provide a fixed monthly payment for a commitment to shed a given load (e.g., ISO/RTO capacity programs or utility interruptible/curtailable rates) are the easiest to incorporate into an ESPC/UESC. ○ For some measures like solar PV, local data on hourly generation and usage can be helpful in estimating time-based energy demand reduction and reducing risk. ○ Energy demand reduction from energy storage (thermal and electric) and combined heat and power (CHP) are often included in ESPC/UESC business cases.
Policy Development
• Prepare draft guidance document and review with key stakeholders (FEMP, ESPC/UESC contract managers, finance, and utilities) to provide ambitious, practical recommendations. • Recommend policy changes at the state level to reflect changes needed in tariffs to facilitate building-grid integration.
Proposed Implementation Steps
• Overall: Support FEMP in developing an implementation approach through policy, pilot projects, and best practices training (focused on federal agencies, utilities, and ESCOs). • Schedule interviews • Document common building-grid integration technologies and strategies/measures • Document methods of accounting for demand reduction in projects • Document implications for project business case, guarantees and M&V (e.g., discounting predicted savings initially and over time) • Document barriers to taking full credit for demand-reduction cost savings (e.g., changes in tariffs, DR program payment uncertainty) • Document recommendations for policy guidance (e.g., always allow demand reduction cost savings, provide longer term credit for demand reductions by conservatively stipulating rates). Work through

analytical issues, e.g., potentially incorporating escalation rates into performance contracts (different from the NIST-prescribed energy rate ones) to factor in long-term energy demand reductions. Due to complexities, estimation of demand savings may require less straightforward calculations than conventional electricity (kWh) savings.

- Provide training for staff negotiating and managing performance contracts to help them understand how to incorporate demand reduction and demand savings.

E. Pilot to practice
Goals

- The development of grid-integrated buildings requires new approaches to the design process, including the incorporation of new types of information and analyses into decision-making. To support the development of strong guidance on these processes, the deployment of grid integration strategies in upcoming projects on a pilot basis can provide critical information about the best ways to interact with design teams and how the design process can best deploy grid information in a timely and effective way.
- Pilot projects can also help to build linkages with local utilities and give GSA staff and design teams experience in considering grid integration in design. Lessons from pilot projects become a strong basis for development of design protocols and guidance that is planned to support grid integration (Section C above).
- Specific goals of deploying grid integration pilot projects include:
  - Exploring utility outreach strategies to support the collection of localized grid data that represent local grid conditions to which buildings should respond.
  - Evaluating existing utility rates and exploring opportunities for rate design and rate structures that would reduce costs, energy use & carbon emissions
  - Working with varied design teams to understand how grid integration efforts best fit into conventional design process and schedule, and to build information and evaluation resources that respond to these processes.

- Determining best practice interactions with design teams that allow the teams to understand and prioritize different elements of grid integration.
- Working with commissioning and operations staff to understand and deploy grid integration features of buildings.
- Identifying GSA procedures that support or limit the incorporation of grid integration features in the design and construction process.

Approach

- Identify upcoming projects in grid constrained regions with the most promise for integration pilots (e.g., campuses)
- Append grid integration analysis to project scope.
- Work with GSA representatives to engage with design team to set grid integration priorities.
- Work with design teams to implement grid integration priorities.
- Collect information about project successes and challenges for grid integration to support broader guidance on grid integration strategies.

Proposed Lead Agencies and Roles

- GSA, DOE FEMP and BTO should collaborate to determine the need for pilot projects per these goals and recommended actions/steps, and follow up as appropriate.
- GSA and other agencies delegated authority to procure electricity are most likely agencies to lead pilots. GSA and DOE/FEMP can coordinate participation of other agencies in pilots through the ISWG. CEQ could help by developing challenges encouraging pilot participation.

Research Steps

- Identify grid constrained regions to focus on for pilot project deployment and evaluate the degree of alignment with GSA regions and other agency delineations.
- Define preliminary project requirements for pilot deployments.

Policy Development

- Set participation targets by agency. These could be defined as a minimum number of pilot projects per year, a proportion of all projects over the year (for example, 25% of all GSA new construction), or a portion of all projects in certain locations (grid constrained locations or GSA regions).
- Draft requirements for pilot project participation.

• Integrate pilot project requirements into GSA, FEMP and other agency guidance, or an executive order.
Proposed Implementation Steps

• Pilot project deployments should share the following key actions:
  ○ Explore utility outreach strategies to support the collection of localized grid data that represents local grid conditions to which buildings should respond.
  ○ Work with varied design teams to understand how grid integration efforts best fit into conventional design process and schedule, and to build information and evaluation resources that respond to these processes.
  ○ Determine best practice interactions with design teams that allow the teams to understand and prioritize different elements of grid integration.
  ○ Work with commissioning and operations staff to understand and deploy grid integration features of buildings.
• Document results through case studies and other reports.
• Define best practices based on pilot projects.
• Work with agencies, designers, utilities, and other stakeholders to bring best practices into the mainstream for project delivery.

Part III: Conclusions and Next Steps

As the nation's electricity grid continues its rapid evolution, the nation's building stock faces significant challenges – as well as opportunities – to transform how it interacts with the grid. As stated in the Vision Statement above - *Federal buildings can be designed, built, retrofitted, and operated to be smart, connected, and responsive assets that optimize interactions with the power grid in order to achieve agency missions reliably and cost-effectively. These solutions provide a compelling business case for GSA through operational cost savings and increased property value, while also reinforcing national priorities like a more resilient power grid.*

Federal agencies have a real opportunity to enhance grid interactivity. The benefits that GSA and other federal agencies stand to gain are real and substantial, including direct impacts from energy cost savings (estimated at 20%) and building energy security improvements as well as broader societal impacts such as grid resiliency and emissions reductions. By applying and documenting building-grid integration measures and strategies in a pilot project context, GSA will help other federal agencies and the private sector learn from its projects. The technology underlying these opportunities is implementable today and in many cases already exists in GSA's building portfolio.

The steps laid out in this proposed roadmap demonstrate an achievable, high impact, and visionary path that GSA could take to demonstrate leadership on this increasingly important issue. This proposed roadmap defines a series of next steps, but further work will need to be done for GSA to take advantage of building & grid integration benefits across its portfolio. Proposed next steps for federal agencies (GSA and others) include:

1. Survey relevant work currently being done on building-grid integration
2. Integrate specific timelines and key performance indicators (KPIs) for each element of the proposed roadmap
3. Work with the agency leads in the Interagency Sustainability Working Group (ISWG) to implement their portion of the proposed roadmap
4. Identify research gaps and priorities
5. Identify projects suitable for pilots
6. Continue coordinating with agencies and organizations involved in federal building & grid integration efforts

The Task Group appreciates the opportunity to define a proposed roadmap for GSA to take the lead on building-grid integration and we hope that this document is helpful and instructive.

Appendices:

A. Task Group Members & Observers

B. Case Examples

Appendix A
Federal Building & Grid Integration: Proposed Roadmap
Task Group Members & Observers

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Appendix B
Case Examples

(Note: projects are listed below under the most applicable recommendation category, but many are relevant to additional categories as well.)

Building & grid interaction policies for all federal buildings:

- California Department of General Services: Automated Demand Response policy
  - Mandates state agency involvement in demand response programs
- Boston Smart Utilities Policy:
  - Requires commercial building projects equal to or greater than 1.5 million square feet to install a microgrid if feasible.

Grid and rate analysis:

- Massachusetts Commercial and Industrial (C&I) Active Demand Management Initiative.
  - See Massachusetts Three-Year Energy Efficiency Plan, pp. 75-76.
  - Demand reduction program coordinated with utility National Grid, through which customers can receive incentives for curtailment using any combination of technologies and strategies.
- Sacramento Municipal Utility District (SMUD) PowerDirect Automated Demand Response Program:
  - Businesses that agree to install an automated demand reduction system receive a $5/kW/month incentive for a one-year commitment
- NYSERDA Real-time energy management (RTEM) program:
  - Incentives to install building systems that gather energy data and provide analysis for optimization of usage. These in turn enable demand management, as discussed here.
- Dominion battery storage pilots:
  - Utility pilot in Virginia to better understand and analyze the use of energy storage for grid stability support
- Xcel Energy Panasonic Battery Demonstration Project

- Xcel Energy, Panasonic and Denver International Airport are partnering on a battery/microgrid/renewables demonstration project, including voltage management and peak reduction goals

Planning and design for new and existing federal buildings:

- Boston Smart Utilities Master Plan for District-Energy Microgrids

Pilot to Practice:

- GSA Region 3: Philadelphia Custom House and Moorhead Federal Office Building
    - Phil Coleman, LBNL, provided these early examples of federal buildings employing load management, with lessons learned, to the Task Group, Phase I, in August 2018
- Fort Carson, CO:
    - 8 MW battery installed and being operated as a load management (peak-shaving/load-shifting) asset, supporting renewables integration and microgrid, and potentially in the future including frequency and voltage support for the base's distribution grid
- Miramar Marine Corps Air Station;
    - Installation-level microgrid incorporating renewables (landfill gas and PV), storage and large-scale HVAC demand response; also, building-level microgrid incorporating zinc bromide flow battery and potential vehicle to grid integration
- Otis Air National Guard Base:
    - DOD's first wind-powered microgrid, including an intelligent, 1.6-MW battery, with goals for peak reduction and participation in frequency regulation programs