A photograph of a power line tower against a sunset sky with clouds. The sun is low on the horizon, creating a bright orange and yellow glow. The sky transitions to a clear blue at the top. Several power lines stretch across the frame, supported by towers. The overall scene is a mix of industrial and natural elements.

FEDERAL BUILDING & GRID INTEGRATION ROADMAP TASK GROUP

September 12th, 2019

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Sonia Punjabi, PG&E

GREEN BUILDING ADVISORY COMMITTEE, BUILDING & GRID INTEGRATION TASK GROUP MEMBERS AND DESIGNEES

Task Group Members or Designees

- Sonia Punjabi, PG&E, Co-Chair
- Ralph DiNola, NBI, Co-Chair
- Cara Carmichael, RMI
- Chris Castro, City of Orlando
- Mark Frankel, NBI
- Matt Jungclaus, RMI
- David Kaneda, Integral
- Alexi Miller, NBI
- Clay Nesler, JCI
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- Victor Olgyay, RMI
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- Kent Peterson, P2S Engineering
- Chris Pyke, USGBC
- Jane Rohde, JSR Associates
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- Sarah Slaughter, Built Environment Coalition

GSA Attendees

- Ken Sandler, GSA, DFO
- Don Horn, GSA
- Kinga Porst, GSA
- Ken Shutika, GSA

Other Attendees

- Nancy Ander, CA DGS
- Paul Bertram, PRB Connect
- Dan Burgoyne, CA DGS
- Ryan Colker, ICC
- Phil Coleman, LBNL
- Mary Ann Piette, LBNL
- Sheila Hayter, ASHRAE
- Rodney Sobin, NASEO

TASK GROUP PROCESS

This document represents the work of the Building & Grid Integration task group – a subcommittee of the General Services Administration (GSA)'s Green Building Advisory Committee that was formed after the Committee's Fall 2018 meeting to develop a roadmap on this issue.

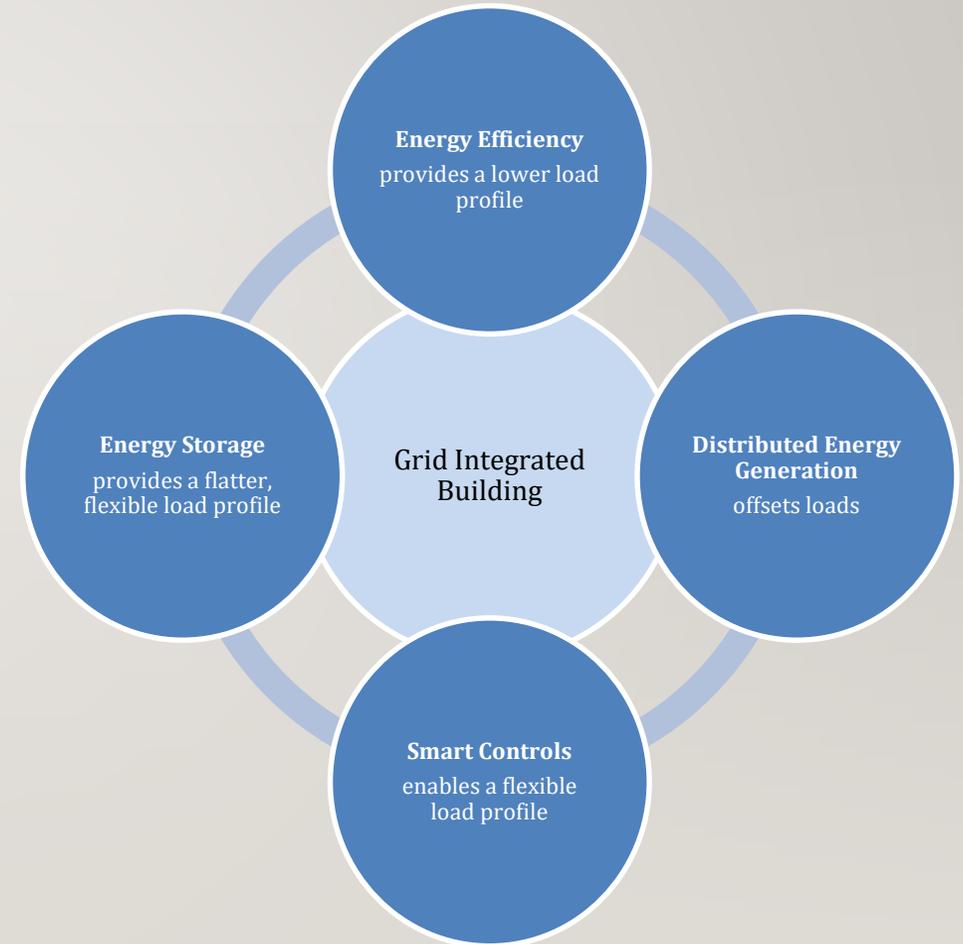
The Task Group met on a biweekly basis between November 2018 and September 2019 to investigate and help build a common understanding regarding the opportunities for federal building and grid integration, and draft this proposed roadmap for the federal government to consider.



WHAT IS A GRID-INTEGRATED BUILDING?

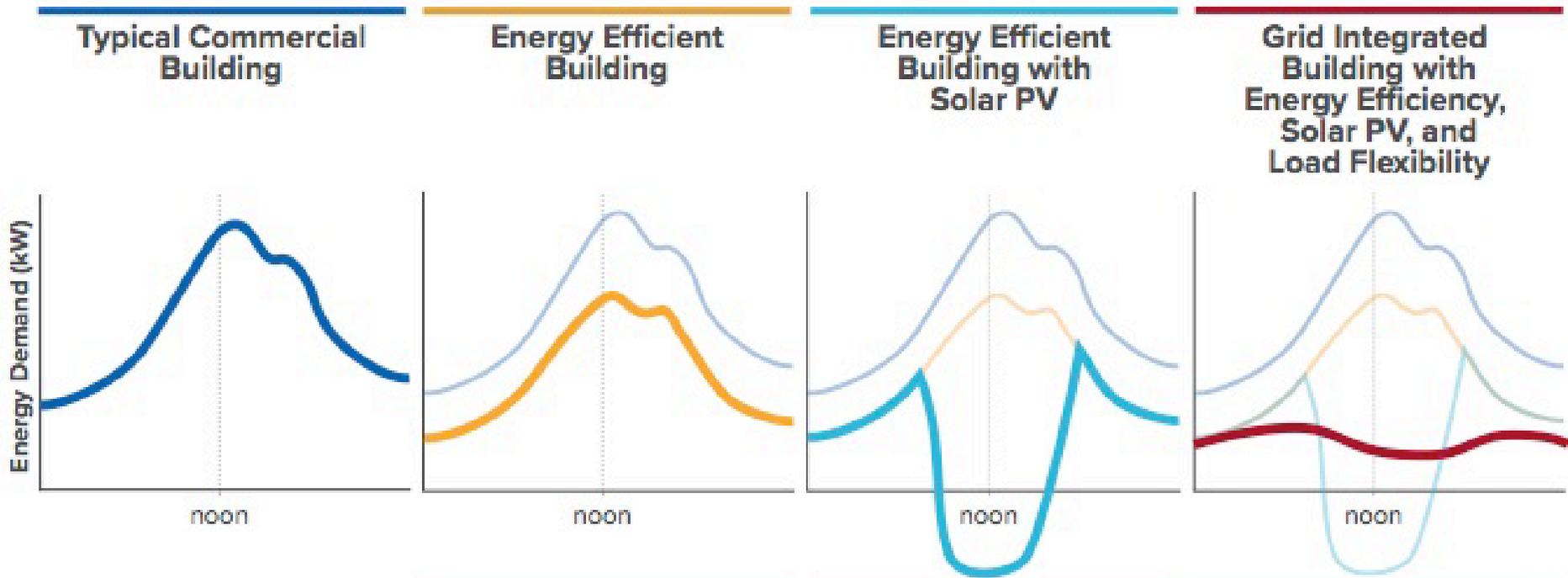
Grid-Integrated Buildings have a holistically optimized blend of energy efficiency, distributed energy generation, load flexible technologies/smart controls, and energy storage.

- Create a lower, “flatter”, more flexible energy load profile
- Have flexible demand
- Are more resilient and productive
- Optimize capital investments
- Reduce operating costs
- Provide access to new revenue for both building owners and utilities



BENEFITS

Grid Integrated Building: Load Profiles

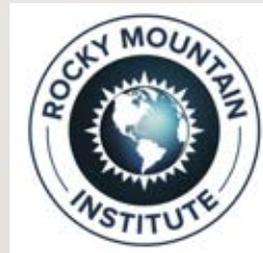


BENEFITS (CONT'D)

Building-grid integration 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.
- These strategies can help advance a variety of federal energy and environmental goals, including minimizing energy consumption, diversifying energy supplies, minimizing carbon emissions, and maximizing utilization of distributed and renewable generation assets, in a coherent and integrated manner.

THE ECONOMICS OF GRID-INTERACTIVE EFFICIENT BUILDINGS (GEBs) IN GSA'S BUILDING PORTFOLIO



CARA CARMICHAEL, MATT JUNGCLAUS, PHIL KEUHN
ROCKY MOUNTAIN INSTITUTE

JULY 2019

THE ECONOMICS OF GRID-INTERACTIVE EFFICIENT BUILDINGS (GEBs) IN GSA'S BUILDING PORTFOLIO: KEY FINDINGS (1 OF 2)

1 Context and approach

- a. **GEBs is a GSA priority:** RMI was hired to assess potential of a Grid-interactive efficient buildings (GEBs) strategy
- b. **Scope of GEBs measures:** Measures that address demand: load flexibility, peak load reduction, and demand response. RMI modeled 29 GEBs measures across 6 locations to show the value of GEBs to the GSA, the federal government, and taxpayers

2 The Value of GEBs

- a. **Substantial energy impacts:** These measures can generate 165 MW of peak load reduction and 180 GWh/y in energy savings across the GSA's owned office portfolio
- b. **Substantial economic impacts:** Each model shows a sub-4 year payback. The full portfolio can generate \$50MM in annual cost savings (20% of the GSA's annual energy spend) and \$184MM in NPV over 8 years
- c. **Adoptable measures:** HVAC, lighting, plug load, renewable energy, and storage measures define the cost-optimal strategy
- d. **Potential to be price-maker:** GSA is large and concentrated enough to impact grid-level economics
- e. **Persistent savings:** GEBs measures enable load flexibility, which ensures savings, even as rate structures change

3 A GSA GEBs strategy should prioritize

- a. **Investment in fully controllable systems.** For example, many GSA buildings have LEDs, but fully controllable fixtures provide much more value.
- b. **Staging of large building loads** like electric heating, AHU fan motors, and plug loads. Staged loads are an untapped source of demand savings and require little-to-no new equipment.
- c. **Consistent demand management and peak shaving.** Year-round demand management delivers greater value than demand response in most scenarios.
- d. **Battery storage and solar PV.** These technologies make economic sense in most locations, but to varying degrees. Falling first costs make these technologies more important for future projects.

THE ECONOMICS OF GRID-INTERACTIVE EFFICIENT BUILDINGS (GEBs) IN GSA'S BUILDING PORTFOLIO: KEY FINDINGS (2 OF 2)

4

Recommended next steps

a. Fold GEBs measures into current projects and pipeline:

- i. GEBs measures have a short payback and a high NPV - they should be implemented now to capture value
 - 1. This makes GEBs valuable for buying down longer-payback measures in ESPC and UESC projects
 - 2. Quick paybacks reduce the risk of uncertainty around future utility pricing, including demand charges
- ii. GEBs measures should be evaluated in all upcoming projects, including demand charge savings
- iii. Controllable fixtures and building controls for reducing peak demand should be included in a standard spec, and required when fixtures are changed and controls are re-programmed

b. Develop dedicated GEBs pilots to generate proof points:

- i. Prioritize locations with high demand rates or time of use rates, including include NYC (\$3.1MM NPV, 2.3 yr payback) and Fresno (\$4.0MM NPV, 3.7 yr payback)
- ii. Applying GEBs to all-electric buildings should be a top-priority - they generate double the net present value compared to dual fuel buildings

c. Develop and/or adopt a building performance metric that considers electric demand (e.g., demand load factor)

5

The value of GEBs will increase over time

a. GEBs could generate up to \$70MM/yr* 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.

- b. The 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)
- c. Utility rate structures are trending toward higher demand charges, time of use rates, and seasonal variation – all of which make GEBs projects more lucrative

* Maximum figure, which assumes that load flexibility and peak reduction align with grid coincident peaks. This is not an absolute figure.

ADDITIONAL RESOURCES

- Rocky Mountain Institute - GEBs Homepage
 - <https://rmi.org/gebs>
- GSA Green Building Advisory Committee Advice Letter on Building & Grid Integration (Phase I)
<https://www.gsa.gov/cdnstatic/Bldg%20Grid%20Integration%20Advice%20Letter%202-21-19%20-%20508.pdf>
- DOE BTO – GEBs Homepage
 - <https://www.energy.gov/eere/buildings/grid-interactive-efficient-buildings>
- Berkeley Lab – FlexLab
 - <https://flexlab.lbl.gov/>
- New Buildings Institute – GridOptimal Initiative
 - <https://newbuildings.org/resource/gridoptimal/>
- NASEO/NARUC – States Working Group
 - <https://www.naseo.org/issues/buildings/naseo-geb-resources>
- More to come from ASHRAE, NREL, ACEEE, and many others...

TASK GROUP OUTCOME

Create a Roadmap to help advance the adoption of Building & Grid Integration in the Federal Sector

- Help agencies meet their missions
- Can be broadly applicable and adopted
- Leverage technologies and strategies to dynamically shape energy loads
- Provide resilience and valuable services to the power grid while saving money for the taxpayer



TASK GROUP FRAMEWORK OVERVIEW

Contents

1. Introduction, Mission, Vision, Problem Statement, and Benefits & Costs
2. Proposed Roadmap
 1. Introduction– Goals and Approach (Overarching)
 2. Specific for each task group (example table shown to the right)
 - A. Building & grid interaction policies for all federal buildings:
 - B. Grid and rate analysis
 - C. Planning and design for new and existing federal buildings
 - D. Energy savings performance contracts and utility energy service contracts
 - E. Pilot to practice
3. Conclusion and Next Steps

B. Grid and rate analysis
Goal
Key Findings
Approach
Proposed Lead Agencies
Research Steps
Policy Development
Proposed Implementation Steps
Case Examples

TASK GROUP MISSION AND VISION

Mission Statement:

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

Vision Statement:

Federal buildings are designed, built, retrofitted and operated to be smart, connected, responsive assets for optimal interaction with the power grid. 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.

TASK GROUP I SUMMARY OF RECOMMENDATIONS

- **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

KEY OVERARCHING ROADMAP RECOMMENDATIONS

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 (in kW), energy costs, and emissions reduction.

B. Grid and rate analysis:

- Collaborate with utilities and grid operators to analyze the grid system and understand and take advantage of flexible rate structures.

C. Planning and design for new and existing federal buildings:

- Plan and design new buildings and existing building retrofits for grid interactivity.

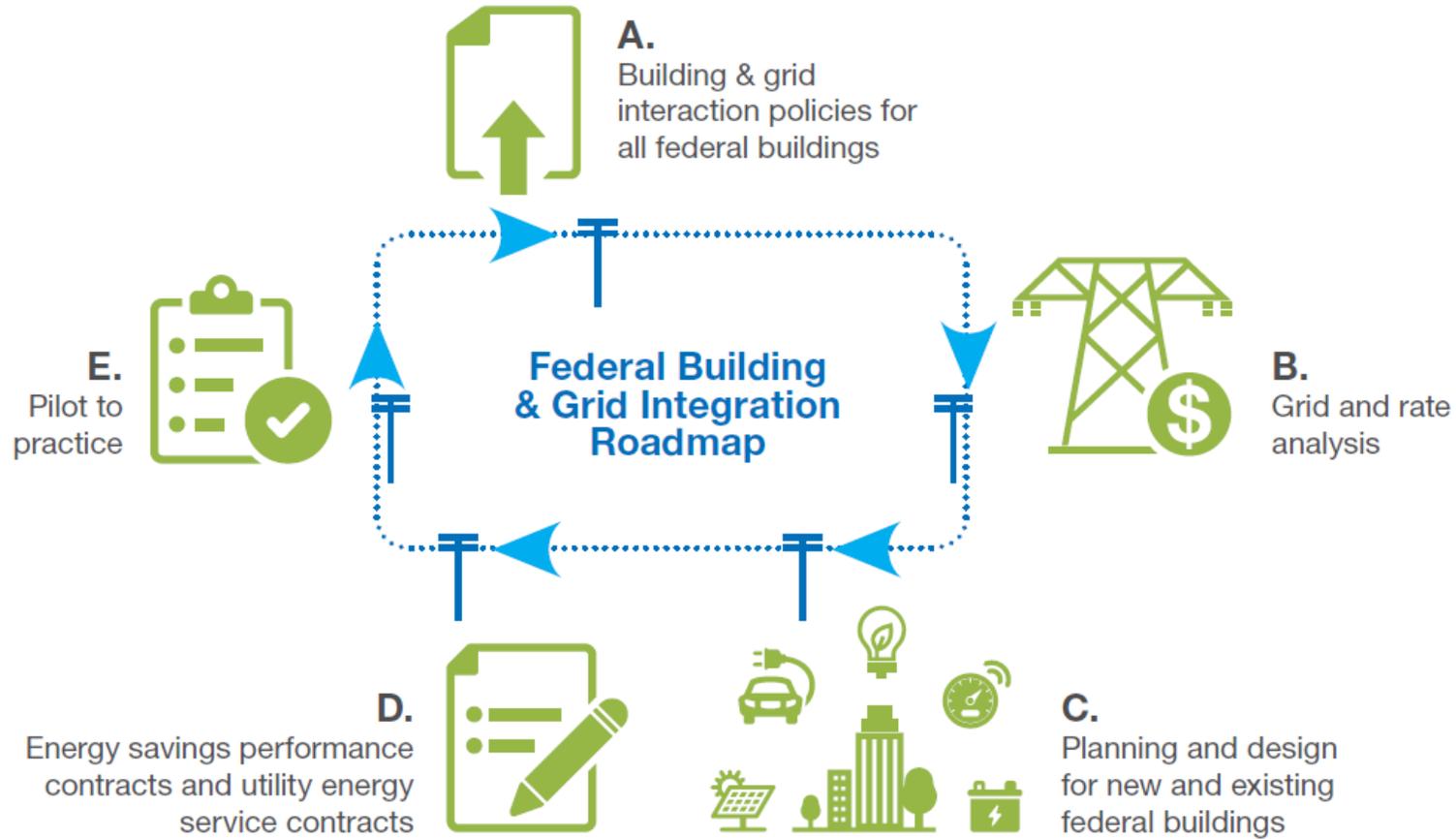
D. Energy savings performance contracts and utility energy service contracts:

- 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.

BUILDING & GRID INTEGRATION ROADMAP



SPECIFIC ROADMAP RECOMMENDATIONS

A. Building & grid integration policies for all federal buildings

- Review and modify federal energy policy goals
- Adopt standardized metrics for buildings
- Need policy, guidance and training
- Outline steps to integrate into standards and requirements for federal facility design and operations
- Avoid blended electricity rates
- Identify impacts of policies and directives, determine and execute pilot projects, evaluate results and refine policy measures to apply to relevant federal facilities
- Finalize federal policy
- Longer term, work with utilities on special rates

SPECIFIC ROADMAP RECOMMENDATIONS

B. Grid rate and analysis

BI. Analyze the Grid System (Was formerly Goal C-I in the original Advice Letter)

- Develop collaboration among utilities, grid operators and federal agency staff to have access to seasonal grid load profiles
- Analyze the grid load profile data and provide information to key federal planners and decision-makers
- Use grid data to inform building performance goals
- Identify key time periods where building response would be beneficial to grid operation
- DOE BTO and FEMP, working with the DOE Office of Electricity and others. necessary. GSA PBS Energy Division, and other agencies

SPECIFIC ROADMAP RECOMMENDATIONS

B. Grid rate and analysis: B I. Analyze the Grid System (continued)

- Gather information on local, regional and national grid conditions, including national (e.g., FERC) and regional policy goals
- Identify how the data on grid characteristics should be analyzed and applied in the context of portfolios, campuses and individual building projects
- Develop policies that guide and require grid data be gathered and incorporated into programs and projects along with feedback loops
- Create an on-line resource for building decision-makers, planners, managers and others to access for local and regional grid information

SPECIFIC ROADMAP RECOMMENDATIONS

B. Grid rate and analysis

B2. Understand and Take Advantage of Flexible Rate Structures (Was formerly Goal C-2 in the original Advice Letter)

- Understand and take advantage of flexible rate structures
- Provide information on flexible rate structures to federal agencies and facilitate their use
- Identify and install building-level infrastructure
- Partnering with utilities and RTOs/ISOs, where appropriate, conduct rate analysis and pilot projects
- Work with local utilities on pilot rate structures to support and incentivize flexible building operation

SPECIFIC ROADMAP RECOMMENDATIONS

B. Grid rate and analysis: B2. Understand and Take Advantage of Flexible Rate Structures (continued)

- Lead Agencies: DOE BTO and FEMP, working with the DOE Office of Electricity and other partners as necessary. GSA PBS Energy Division, and other agencies
- Integrate into GSA, FEMP and other agency guidance, or an executive order
- Implement by developing draft guidance that might be used as a template for individual federal departments or agencies
- Share/vet draft guidance with agencies in order to refine and also to assess uptake feasibility

SPECIFIC ROADMAP RECOMMENDATIONS

C. Planning and design for new and existing federal buildings (Combines former Goals A-2 and B-1 in the original Advice Letter)

- New buildings and existing building retrofits are planned and designed for grid interactivity
- Understand what building characteristics and measures would provide optimal building load profiles
- Facilitate the adoption of specific building infrastructure and performance features to support grid integration
- Identify and deploy building-grid integration technologies and strategies
- GSA, DOE FEMP and BTO should coordinate to develop building and grid integration design guidance
- GSA PBS should add key design recommendations to the P-100 Facility Standards

SPECIFIC ROADMAP RECOMMENDATIONS

C. Planning and design for new and existing federal buildings (continued)

- Define key parameters, and values for those parameters, to set facility design and operational requirements
- Identify and undertake pilots and evaluate impacts
- Document lessons learned through case studies and other output documents
- 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

SPECIFIC ROADMAP RECOMMENDATIONS

D. Energy Savings Performance Contracts and Utility Energy Service Contracts

(Formerly Goal A-3 I in the original Advice Letter)

- Develop and adopt a policy to encourage savings from energy demand reduction in ESPC/UESC projects
- Document best practices and provide policy guidance for federal ESPC/UESC projects
- Document implications for project business case, guarantees and M&V
- Work with state energy offices, utilities and public utility commissions to adopt special tariffs
- Provide education and training on the benefits and best practices
- Coordinate with FEMP, GSA's ESPC/UESC program Management Office, and other agencies

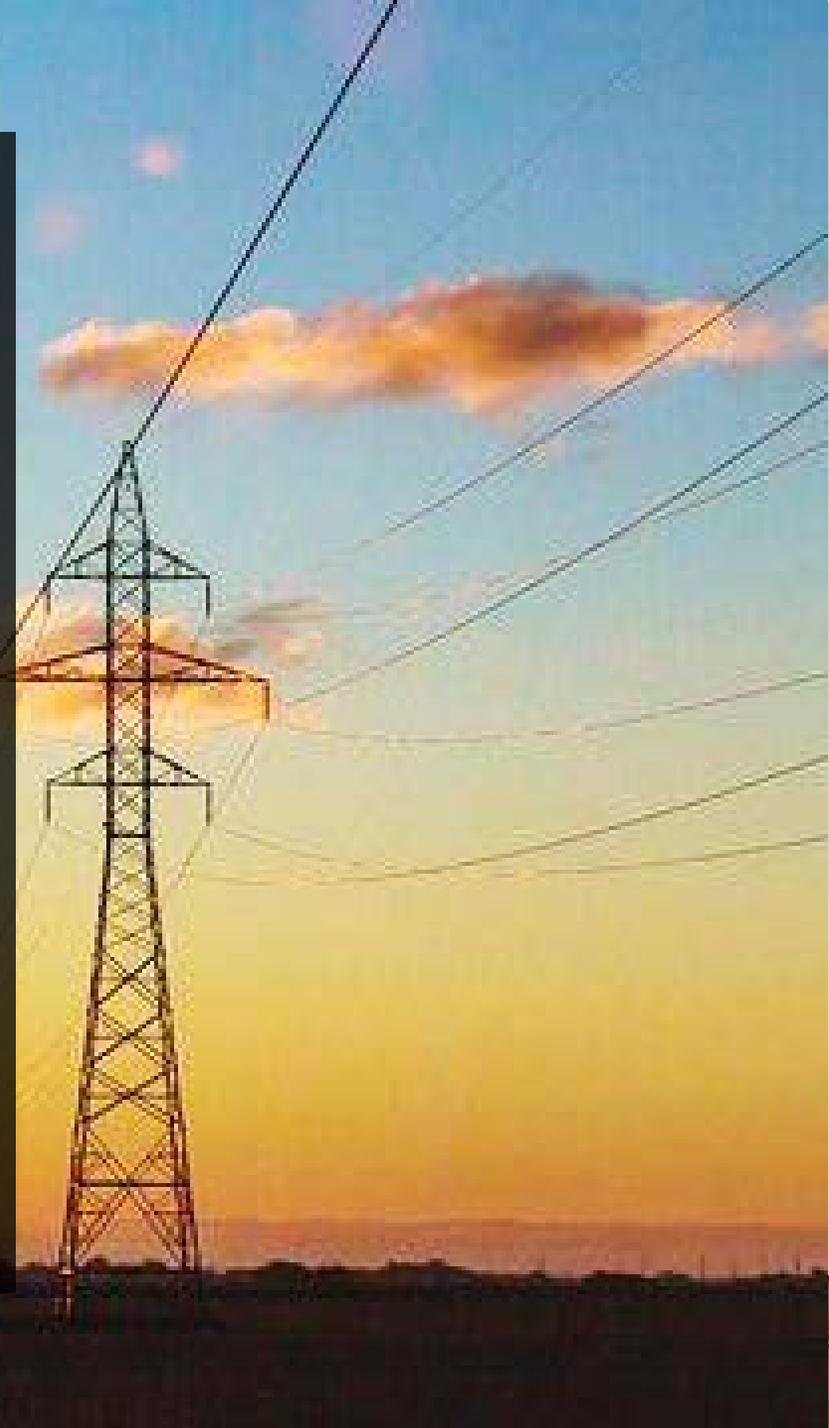
SPECIFIC ROADMAP RECOMMENDATIONS

E. Pilot to Practice

- Field test and evaluate new approaches
- Develop experience in considering grid integration
- Identify grid constrained regions to focus on for pilot project deployment
- Define preliminary project requirements for pilot deployments
- Draft requirements for pilot project participation and integrate pilot project requirements into GSA, FEMP and other agency guidance
- Set agency targets for pilot
- Document results through case studies and other reports
- Define best practices based on pilot projects

CONCLUSION

- As the nation's electricity grid continues rapid evolution, the building stock will face significant challenges – and significant opportunities – to transform how they interact with the grid
- Federal agencies have a real opportunity to enhance their grid interactivity
- Applying 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



GROUP DISCUSSION – SCALING AND NEXT STEPS

- Questions or suggestions?
- What does success look like for grid-integrated federal buildings?
- Should specific KPIs and a Timeline be defined?
- To increase impact, how can we (GSA and GBAC) encourage broad distribution?
- How can we encourage adoption?
- How should we leverage the powerful network of key industry stakeholders established through this work?