Building & Grid Integration: A New Frontier for Federal Buildings

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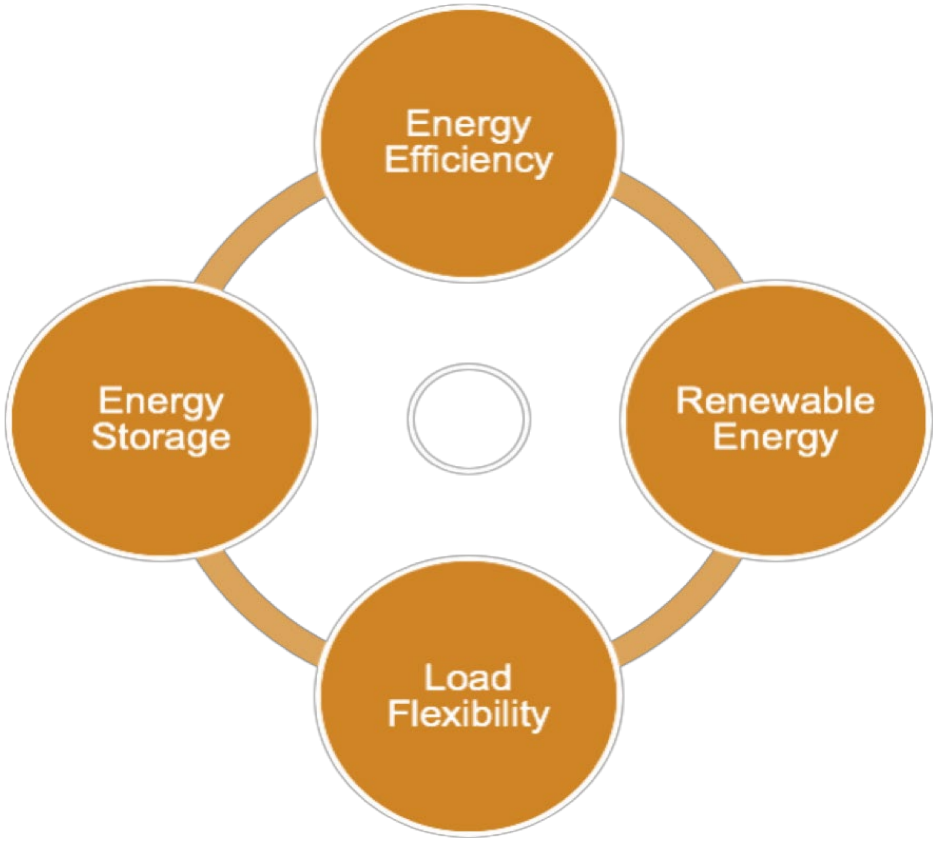
Outline of Today's Discussion

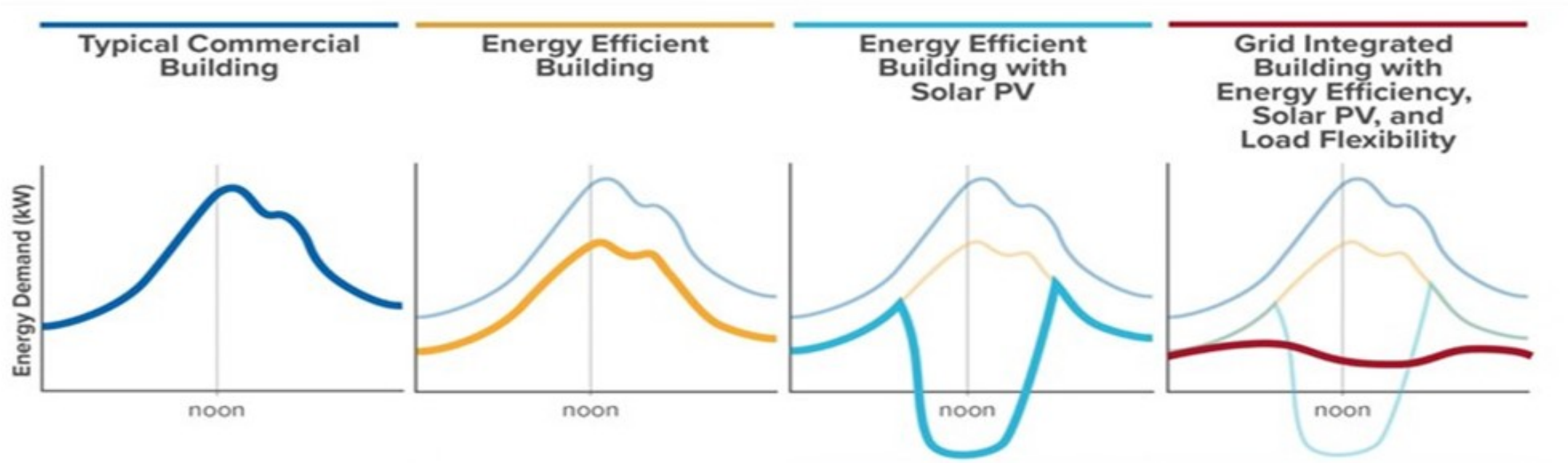
- Understanding Grid-Interactive Efficient Buildings (GEBs)
- GSA Advisory Committee Findings & Recommendations
- GSA/RMI GEB Analysis
- GSA GPG & Other Pilots
- Takeaways
- Q&A

What are Grid-interactive Efficient Buildings (GEBs)?

- A GEB strategy brings together the clean energy potential of both buildings and the grid
- GEBs achieve a balance of energy efficiency, renewables, energy storage and load flexibility
- GEBs employ all these capabilities to flexibly **reduce, shed, shift, modulate or generate** electric load as needed
- In response to utility price signals, a GEB can reduce costs and enhance resilience for both building and utility



The GEB Concept



- Enhancing the capabilities of buildings to flexibly reshape loads can address multiple challenges at once:
  - Energy efficiency, cost savings, carbon reduction, renewable energy deployment, grid resilience, smart technology adoption, etc.

How Can GEBs Save Building Owners Money?

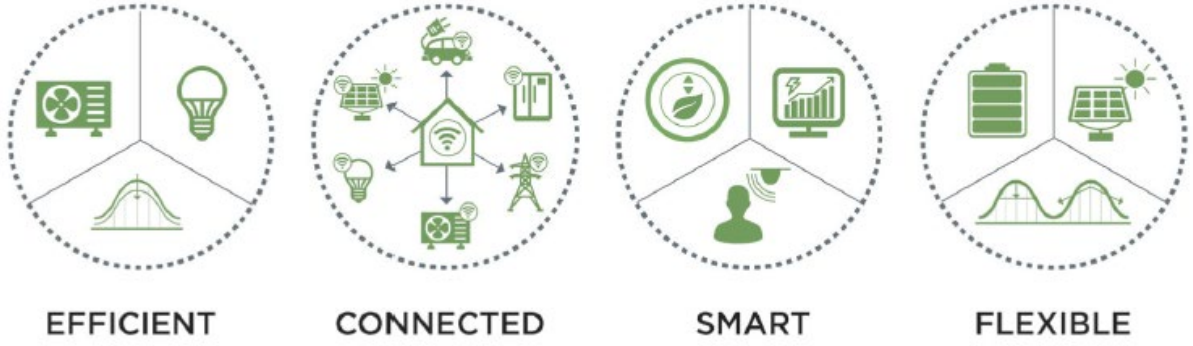
- Overall efficiency
- Demand charges:
  - Reduce charges utilities use to bill customers for highest demand periods
- Demand response:
  - Sell power reduction as a service to grid via utility or ISO/RTO programs
- Time of use rates (or other dynamic pricing):
  - Take advantage of special rates that vary based on time of day
- Utility rebates and incentives

*Note: grid integration may *not always* save overall energy or GHGs, e.g., depending on strategies or how batteries are operated

Technological Pathways Evolving

Attribute	Today	Future
1. Building systems controls and integration	• Building management system (BMS) for major loads (HVAC) • Individual system controls (lighting, storage)	• Single, overarching integrator to monitor and control all loads (including plug loads & storage) • Ability to optimize (for cost, carbon, reliability, etc.)
2. Building to grid interoperability and communications	• Demand response (DR) programs (often manual, static)	• Ability to receive and respond to utility price signals • Ability to send load flex potential
3. Load flexibility & demand-focused optimization	• Thermal energy storage • Battery storage	• Intelligence to track and map demand, shift or shed rapidly based on inputs (price, weather, carbon, events, etc.)

Foundational Federal Work on GEBs



- DOE Building Technologies Office (BTO)
  - Identifying definitions, metrics, technological needs
  - Convening & educating states and businesses
  - See www.energy.gov/eere/buildings/buildings-grid-integration
- GSA Green Building Advisory Committee
  - A board of federal & non-federal expert advisors
  - Developed recommendations to federal government: at www.gsa.gov/gbac under Advice Letters & Resolutions

Private-NGO Initiatives

Grid Optimal Initiative

GridOptimal™: How will we do it?

- Bring together **key stakeholders and experts** to develop standards and metrics
- Establish **framework for rating system** that will result in program implementation
- Develop the **rating system**, leveraging existing standards
- Identify **pilot projects** and participants
- Outline **incentive programs** and financing mechanisms
- Provide **Educational Guidance**

Challenges Identified by Advisory Committee

- Lack of Information and Resources
- Lack of Supportive Policies
- Need for Greater Price Incentives
- Security Concerns
- Operational Knowledge Gaps and Lack of Control
- Lack of Integration Among Strategies & Technologies
- Inadequate Financing/Contracting Models

Advisory Committee Recommendations

- Set federal building & grid integration policies
- Conduct grid and rate analyses
- Develop design guidance for new & existing federal buildings
- Incorporate demand savings into ESPCs/ UESCs
- Develop building pilot projects

The ESPC/UESC Challenge

- ESPCs & UESCs draft findings & recommendations:
  - No policy *against* including demand savings
  - Yet they rarely are included
    - Exceptions: energy storage, CHP
  - Fear of unpredictability & savings failing to materialize
  - Need policy, guidance and training
  - Avoid blended electricity rates
  - Longer term, work with utilities on special rates

GSA-RMI Portfolio GEB Study

- Available on Rocky Mountain Institute (RMI) website at https://rmi.org/insight/value-potential-for-grid-interactive-efficient-buildings-in-the-gsa-portfolio-a-cost-benefit-analysis

GSA-RMI Study Goal & Approach

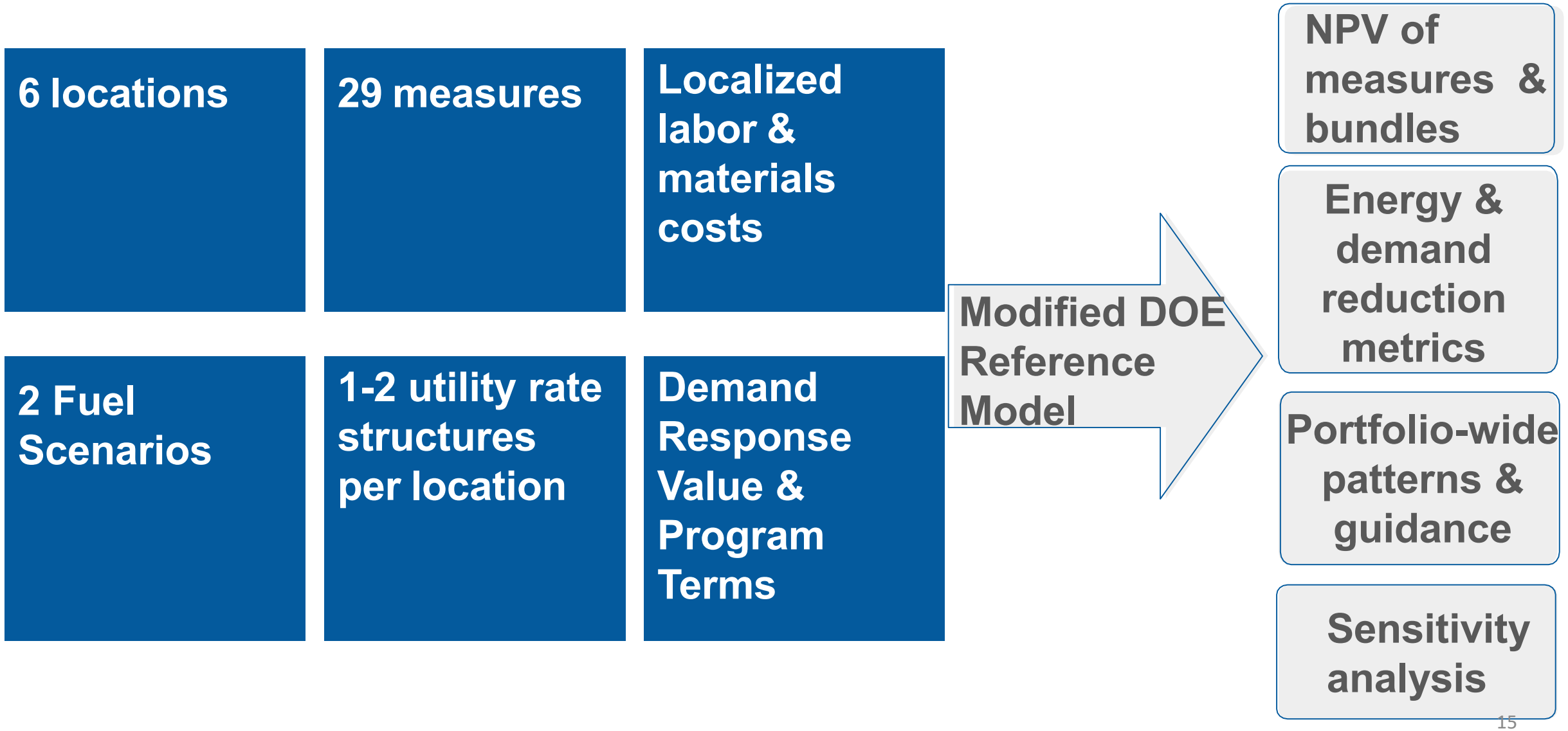
Purpose

- Identify most effective GEB strategies for GSA to save on operating costs

Approach

- RMI evaluated 29 GEB measures in 6 locations with diverse climate zones and rate structures:
  - ❖ CA, NY, GA, MD, AZ and CO
- Applied local labor & material costs; assumed 87% dual fuel, 13% all electric; varied rates & programs
- Identified highest net present value (NPV) measures & extrapolated findings to whole portfolio

Overview of Methodology



GEB Measures Evaluated (1 of 2)

	Simplified Description	Traditional Efficiency	Peak-Focused Reductions	Dynamic Demand Shifting	Demand Response and Grid-Level Services
Lighting	LED fixture w/full control	X	X		X
	LED fixture w/occupancy controls	X			
	LED tube retrofit	X			
Heating and Cooling	Electric resistance heating staging		X		X
	Zone space temp setback	X	X		X
	Window film	X	X		
	Thermal storage			X	
	Chilled water and hot water pumping pressure reset for demand response		X		X
	Energy/heat recovery systems	X	X		

GEB Measures Evaluated (2 of 2)

	Simplified Description	Traditional Efficiency	Peak-Focused Reductions	Dynamic Demand Shifting	Demand Response and Grid-Level Services
Ventilation	AHU fan staging		X		X
	Increased air filtration to reduce outside air (OA) needs	X	X		
	Demand-control ventilation	X	X		
	Static pressure reset for demand response		X		X
Plug Loads	Laptop battery charger staging		X		X
Renewables and Storage	Solar PV array	X	X		
	Electric battery storage		X	X	X

Findings: The Value of GEBs to GSA

1. **Adoptable measures:** HVAC, lighting, plug load, renewable energy & storage measures define the cost-optimal strategy
2. **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
3. **Substantial economic impacts:** Each model shows a **sub-4 year payback**. The full portfolio can generate **$50MM in annual cost savings** (20% of GSA's annual energy spend) and **$184MM in NPV** over 8 years
4. **Potential to be price-maker:** GSA is large and concentrated enough to impact grid-level economics
5. **Persistent savings:** GEB measures enable load flexibility, which ensures savings, even as rate structures change

Findings: Proposed GEB Priorities for GSA

1. **Investment in fully controllable systems.** For example, many GSA buildings have LEDs, but fully controllable fixtures provide much more value.
2. **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.
3. **Consistent demand management and peak shaving**. Year-round demand management delivers greater value than demand response in most scenarios.
4. **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.

Value of GEBs to GSA & Beyond

Direct Benefits to GSA

- $50MM in annual cost savings
- $184MM in NPV
- Project-level payback under 4 years
- Flexibility to accommodate future rate structure changes

Societal Value

- Reduce grid-level T&D and generation costs up to $70MM/yr
- These savings ultimately benefit the government and taxpayers
- Future rate structures will more directly share grid-level savings

Indirect Value

- Demonstrates federal and real estate industry leadership
- Enables deeper savings in ESPCs and UESCs
- Better building control can improve comfort, health, and productivity
- CO_2 savings

Proposed Next Steps

1. **Fold GEB measures into current projects and pipeline:**
   a. GEB measures have a short payback & high NPV – ideally implement now to capture value
   b. GEB measures, including demand charge savings, should be evaluated in all upcoming projects
   c. 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
2. **Develop dedicated GEB pilots to generate proof points:**
   a. Prioritize locations with high demand rates or time of use rates (NYC, Fresno)
   b. Apply GEBs to all-electric buildings as a high priority - they generate double the NPV of dual fuel buildings
3. **Develop and/or adopt a building performance metric that considers electric demand** (e.g., demand load factor)

GSA Pilots

- As a market leader, GSA plans to pilot our own GEBs
- GSA's Proving Ground (GPG) & DOE's Building Technologies Office (BTO) have an RFI out thru 12-9:
  - https://www.gsa.gov/governmentwide-initiatives/sustainability/emerging-building-technologies/request-for-information
  - Seeking GEB technologies to demonstrate
- We are also looking to integrate GEB concepts into our ESPC & UESC projects

Takeaways

- GEBs can provide many benefits to federal buildings
- There are still many issues to work out & policies to develop
- This is an ideal area for pilots to test out strategies
- UESCs & ESPCs are well-positioned to facilitate such pilots
- We are planning GEB case studies – if you have examples, please let us know

Thank You for Your Time

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