FEDERAL UTILITY PARTNERSHIP WORKING GROUP SEMINAR

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Grid-Interactive Efficient Buildings For Energy & Cost Savings

Hosted by:

FEMP Federal Energy Management Program

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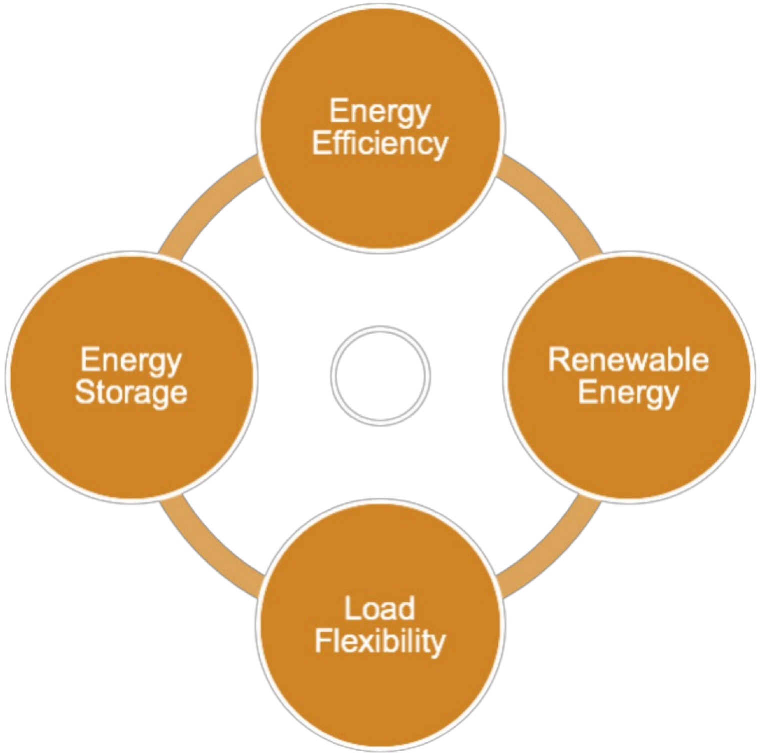
Outline of Today's Discussion

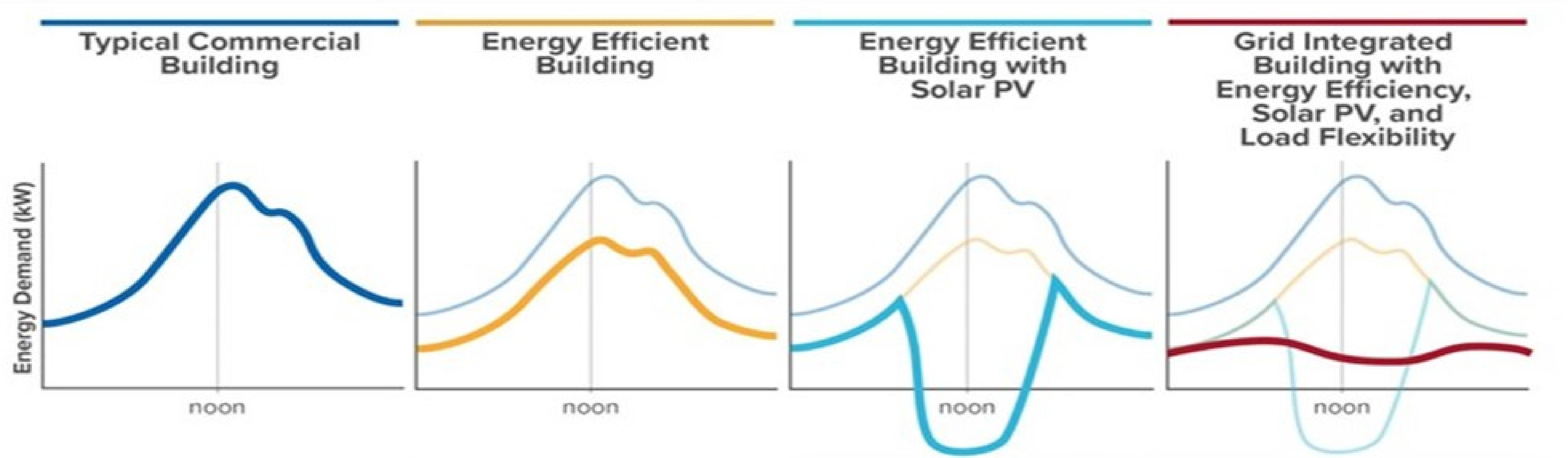
- Understanding Grid-Interactive Efficient Buildings (GEBs)
- GSA Advisory Committee Findings & Recommendations
- GSA GEB Analysis
- GSA Pilots
- Takeaways
- Q&A

What are Grid-interactive Efficient Buildings (GEBs)?

- A GEB strategy joins 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 of 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

GEBs: What Would Change

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 and 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.)

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Federal Work on GEBs

- DOE Building Technologies Office (BTO)
  - Foundational work on definitions & metrics
  - Convening & educating states and businesses
  - More at www.energy.gov/eere/buildings/buildings-grid-integration
- GSA Green Building Advisory Committee
  - Outside advisors, made up of federal & non-federal experts
  - Developed recommendations to federal government: at www.gsa.gov/gbac under Advice Letters & Resolutions

Challenges Identified by Advisory Committee

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

Solutions Proposed

- 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

Overall context and purpose

Purpose of Study	• GSA is evaluating a grid-interactive efficient buildings (GEBs) strategy as a standalone effort or in concert with existing efforts • GEBs use a subset of energy measures focused on when energy is consumed and reducing peak demand
Approach	• RMI evaluated 29 measures in 6 locations to identify the highest net present value GEBs measures and extrapolate the results to the whole portfolio
Intended Use	• This study provides a fact base to demonstrate the value of a GEBs strategy for the GSA and recommends specific strategies for the GSA to save operating costs • This effort complements efforts of the GSA GBAC, DOE BTO, and others • Next steps should include GEBs pilot projects and a holistic analysis of GEBs and deep efficiency measures

How we analyzed GEBs for the GSA Portfolio

6 locations

- CA, NY, GA, MD, AZ and CO
- Variety of climate zones and rate structures, representative of portfolio

29 measures

- Focused on demand reduction

Localized labor and materials costs

- Using vendors supplied equipment costs and location-based labor and material factors

2 Fuel Scenarios

- Assuming 87% of GSA's buildings are dual fuel, 13% are all electric

1-2 utility rate structures per location

- Variation in consumption charges, demand charges and time value; represents current and potential rate structures

Demand Response Value and Program Terms

- Based on quotes and program terms from aggregators

Modified DOE Reference Model

Adjusted to represent a large GSA office

NPV of measures and bundles

Energy and demand reduction metrics

Portfolio-wide patterns and guidance

Sensitivity analysis

Key Findings: GEBs Analysis (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
c. 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.

Key Findings: GEBs Analysis (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 NYC ($2.1MM NPV, 2.3 yr payback) and Fresno ($2.4MM 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

d. GEBs could generate up to $149MM/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.

e. 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)

f. 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.

Three Core Values of GEBs

Direct Benefits to GSA

- $50MM in annual cost savings
- $206MM 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
- CO2 savings

Assumes GEBs are applied across the GSA portfolio of owned office buildings; Based on bundle of measures modeled by RMI.

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Large untapped, cost effective opportunity to invest in GEB measures today

	First Cost of GEBs Measures	Annual cost savings	Payback w Incentives* (yrs)	NPV w Incentives*
Fresno, CA	$2,458,955	$612,178	3.66	$4,006,943
New York, NY	$2,013,386	$429,315	2.30	$3,084,392
Denver, CO	$282,357	$122,803	0.90	$894,312
Phoenix, AZ	$664,291	$207,468	3.15	$1,021,321
College Park, MD	$107,138	$48,251	2.22	$227,549
Atlanta, GA	$190,687	$59,072	2.89	$238,934
Average (unweighted)	**$952,802**	**$246,514**	**2.52**	**$1,578,894**

- GEB measures have **high net present value** and **short paybacks** across all locations, largely due to low first cost measures such as controllability and staging existing equipment.
- Investing now will **secure financial returns,** enable savings to persist as rate structures change.
- The **best returns** are in locations with **high demand charges, time of use rates, and seasonal variation** – and utility rate structures overall are trending in this direction.

*Incentives include local rebates and incentives available to the federal government. This does not include demand response revenue.

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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 through December 2, 2019:
  - 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 are well-positioned to facilitate such pilots
- We are looking for partners to work with on this

What are your questions?