The Economics of Grid-interactive Efficient Buildings (GEBs)

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NASEO/NARUC GEB Working Group Roundtable and Workshop
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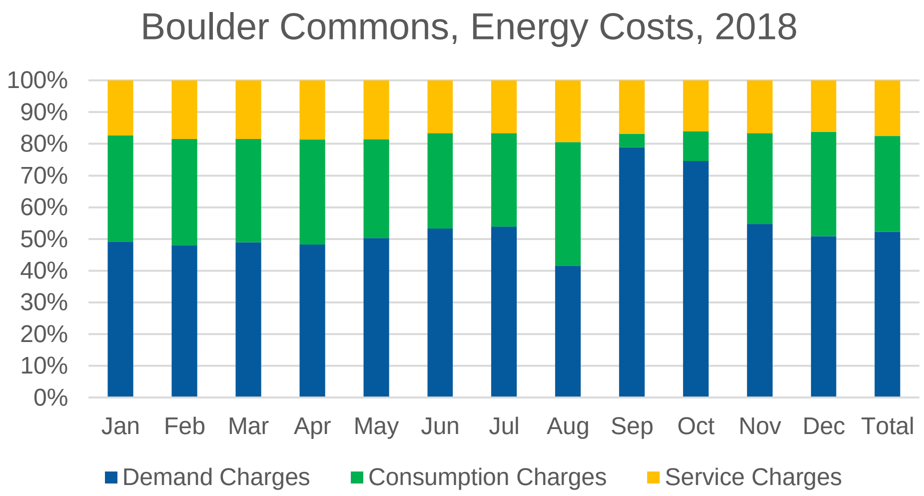
Agenda

1. Findings from The Economics of Grid-interactive Efficient Buildings (GEBs) in GSA's Building Portfolio

2. Key recommendations for Guidance to incorporate Grid-interactive Efficient Buildings strategies into ESPC/UESC projects from GSA Green Building Advisory Committee Task Group.

GEBs are important to building owners/operators: Significant cost savings by managing both consumption and demand

- Demand charges can be up to 60% of annual energy costs
- Most buildings track energy consumption, not necessarily demand
- Shelters buildings against future rate structures changes
- Supports with deep energy retrofits, zero carbon goals



Key differentiators of grid interactive buildings

Attribute	Today	Future
1. Interoperability and intelligence from building to grid	• DR programs, often manual, fairly static	• Ability to receive and respond to utility price signals • Ability to send load flex potential
2. Interoperability and intelligence across building systems	• BMS system for major loads (HVAC) • Individual system controls (Lighting, storage)	• Single, overarching integrator to monitor and control all loads, inc. plug loads and storage • Ability to optimize for cost, carbon, reliability, etc.
3. Load flexibility and demand-focused optimization	• Thermal energy storage • Battery storage	• Intelligence to track and map demand, shift or shed rapidly based on inputs such as price, weather, carbon, events, etc.

Key Findings

The Economics of Grid-interactive Efficient Buildings (GEBs) in GSA's Building Portfolio

Context and Purpose

Purpose of Study	• To explore the strategies and value provided by grid interactive buildings and how that could impact the GSA portfolio. • To inform GSA's GEB strategy
Intended Use	• This study provides a fact base to demonstrate the value of a GEBs strategy for the GSA (and others) • Recommends specific strategies for the GSA to save operating costs • This effort complements efforts of the GSA GBAC, DOE BTO, and others • To inform next steps

Approach

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 vendor-supplied equipment costs and location-based labor and material factors

2 Fuel Scenarios

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

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: Three Core Values of GEBs

Direct Benefits to GSA

- Portfolio: $50 MM annual cost savings, $206 MM in NPV
- Project: 30% average annual cost savings per project, sub 4 year payback
- 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 taxpayers, increase resilience and reliability
- 2x as effective as DR

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

Assumes GEBs are applied across the GSA portfolio of owned office buildings; Based on bundle of measures modeled by RMI. NPV is based on an 8 year time horizon and a 3% discount rate.

Key Findings: Critical ECM’s and Strategies

1. **Adoptable measures:** HVAC, lighting, plug load, renewable energy, and storage measures define the cost-optimal strategy
2. **Investment in fully controllable systems.** For example, many GSA buildings have LEDs, but fully controllable fixtures provide much more value.
3. **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.
4. **Consistent demand management and peak shaving**. Year-round demand management delivers greater value than demand response in most scenarios.
5. **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: Recommended Next Steps

1. **Fold GEBs measures into current projects and pipeline:**
   a. Short payback and a high NPV can help ‘buy down’ longer-payback measures in ESPC and UESC projects
2. **Develop GEBs pilots as proof points in advantageous locations:**
   a. 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)
   b. All-electric buildings are top-priority – 2x NPV vs dual fuel buildings
   c. Locations with high concentrations of same agency buildings, regional leadership and motivated building managers
3. **Develop and/or adopt a building performance metric that considers electric demand (e.g., demand load factor)**

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

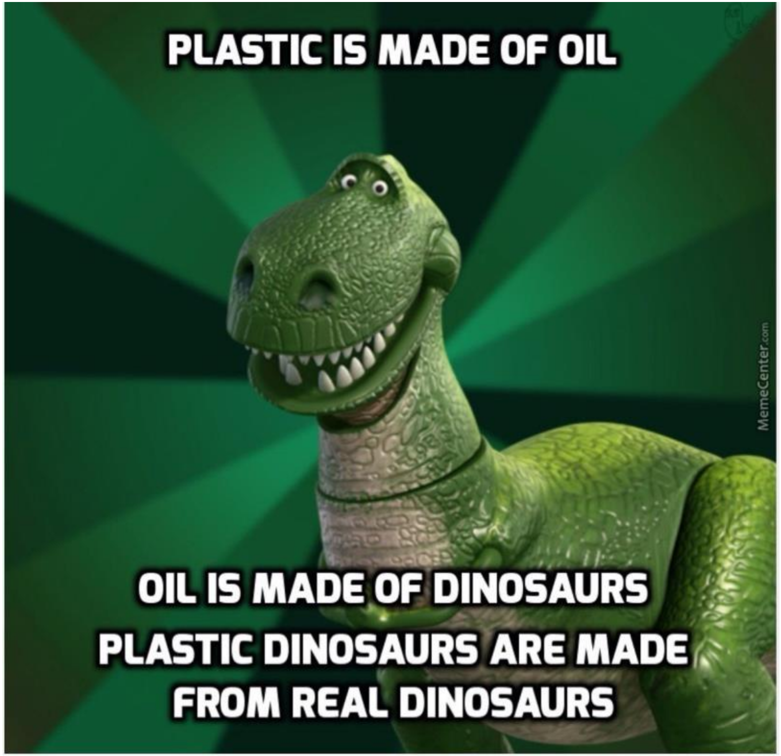
There is a large, untapped, and cost effective opportunity to invest in GEBs measures today

	First Cost of GEBs Measures	Annual cost savings	Payback* (yrs)	NPV*
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**

- GEBs 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.

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

Mental Break



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Key Recommendations

Guidance to incorporate Grid-interactive Efficient Buildings strategies into Federal ESPC/UESC projects

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Key takeaways (1 of 2)

1. **Demand charge savings should be included, but usually aren't**. Preliminary analysis suggests demand savings are more prevalent in UESCs.
2. **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 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."
3. **Don't use blended rates.** The use of blended electricity rates underestimates the value of demand flexibility – consistent with FEMP guidance, using blended rates to calculate savings is discouraged.

Key takeaways (2 of 2)

4. **Training is needed, on both sides of the contract.** The expertise required to identify and quantify and engineer demand reduction measures is specialized and not widely distributed through ESCOs and federal customers and ostensibly 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 O&M, there may be greater risk. In this instance, some form of risk-sharing with the agency customer is likely warranted to keep both parties motivated.
5. **Even a 3 year guarantee for DR is helpful**. The savings from demand response program participation are generally only guaranteed for a few years (three is most common) because programs change and are only known for this period into the future. 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.
6. **Demand response programs are easy**. They provide a fixed monthly payment for a commitment to shed a given load (capacity programs or interruptible/curtailable rates) are the easiest to incorporate into an ESPC/UESC.
7. **It is happening now.** Energy demand reduction from energy storage (thermal and electric) and combined heat and power (CHP) are often included in ESPC/UESC business cases.

On the horizon…

1. RMI's full report (released August 1st) – www.rmi.org/gebs
2. GSA Proving Ground Pilot – RFI this fall
3. GSA Green Building Advisory Committee is releasing ESPC/UESC guidance for grid interactive buildings - this fall
4. Getting to Zero Forum in Oakland in October – www.gettingtozeroforum.org
5. DOD ESTCP Symposium in December

Additional Resources

- Rocky Mountain Institute - Grid interactive buildings Homepage
  - https://rmi.org/gebs
- U.S. General Services Administration – GEBs Advice Letter
  - 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 GEB Working group
  - https://www.naseo.org/issues/buildings/naseo-geb-resources
- More from ASHRAE, NREL, ACEEE, and many others…