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GSA Oklahoma City Federal Building: Smart Buildings Case Study

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List of Acronyms

BAS	building automation system
BESS	battery energy storage system
DOE	U.S. Department of Energy
ECM	energy conservation measure
ESCO	energy service company
ESPC	energy savings performance contract
GEB	grid-interactive efficient building
GHG	greenhouse gas
GSA	General Services Administration
HVAC	heating, ventilation, and air conditioning
IP	internet protocol
IT	information technology
kW	kilowatt
kWh	kilowatt-hour
LED	light emitting diode
MMBtu	metric million British thermal unit
MTE	metric ton of CO_2 equivalent
NREL	National Renewable Energy Laboratory
OG&E	Oklahoma Gas and Electric
OKC	Oklahoma City
PV	photovoltaic
UESC	utility energy service contract

Executive Summary

Demand flexibility can play an important role in helping maintain grid reliability, improving energy affordability, and integrating a variety of generation sources. New and existing grid-interactive efficient building (GEB) technologies can be implemented to create smart buildings—buildings that use sensors and controls to manage peak demand and electricity loads. These smart buildings provide an opportunity to reduce electricity consumption in the building sector.

The purpose of this smart buildings case study is to showcase a leading example of a GEB renovation project in the federal buildings space and provide key information on the project roles, processes, costs, and benefits. The findings from this successful GEB project can be used to help pave the way for additional GEB-ready retrofits in the future.

The General Services Administration's (GSA's) Oklahoma City (OKC) Federal Building, located in downtown Oklahoma City, Oklahoma, demonstrates that GEB-ready strategies and technologies can be realistically deployed today across buildings with minimal investment. The project team implemented nine energy conservation measures (ECMs) and/or smart building technologies, making it a leading example of a smart, sustainable, and efficient commercial building. The case study highlights the challenges and the lessons learned throughout the project design and execution in addition to some of the best practices and considerations when implementing GEB technologies.

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1 Introduction

Growing peak electricity demand, transmission and distribution infrastructure constraints, and an increasing share of variable renewable electricity generation are challenging the electrical grid. As the grid becomes increasingly complex, demand flexibility can play an important role in helping maintain grid reliability, improving energy affordability, and integrating a variety of generation sources. Smart buildings—buildings that use sensors and controls to manage peak demand and electricity loads—can provide flexibility by reducing energy waste, helping balance energy use during times of peak demand and/or plentiful renewable generation, and reducing the risk of utility disruptions.[1]

Buildings offer a unique opportunity for cost-effective demand-side management because they are the nation's primary users of electricity: 75% of all U.S. electricity is consumed within buildings, and perhaps more importantly, building energy use drives a comparable share of peak power demand. The electricity demand from buildings results from a variety of electrical loads that are operated to serve the needs of occupants. However, many of these loads are flexible to some degree; with proper communications and controls, loads can be managed to draw electricity at specific times and at different levels, while still meeting occupant productivity and comfort requirements.[2] New and existing grid-interactive efficient building (GEB) technologies can be implemented to create smart buildings that provide an opportunity to reduce electricity consumption in the building sector.

The purpose of this case study is to showcase a leading example of a GEB renovation project in the federal buildings space and provide key information on the project roles, processes, costs, and benefits. The findings from this successful GEB project can be used to help pave the way for additional GEB-ready retrofits in the future. The Oklahoma City (OKC) Federal Building (Figure 1) demonstrates that GEB-ready strategies and technologies can be realistically deployed today across buildings with minimal investment. The project team implemented nine different energy conservation measures (ECMs) and/or smart building technologies making it a leading example of a smart, sustainable, and efficient commercial building. The case study highlights the challenges and the lessons learned throughout the project design and execution. All information in this report was gathered directly from conversations and materials with the key project leaders involved in this building renovation.

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[1] Neukomm, Monica, Valerie Nubbe, Robert Fares. 2019. *Grid-interactive Efficient Buildings Technical Report Series: Overview of Research Challenges and Gaps*. Washington, DC: U.S. Department of Energy. DOE/GO-102019-5227. https://www1.eere.energy.gov/buildings/pdfs/75470.pdf.

[2] Building Technologies Office. 2020. *Grid-interactive Efficient Buildings: Projects Summary*. Washington, DC: U.S. Department of Energy. DOE/EE-2136. https://www.energy.gov/sites/default/files/2020/09/f79/bto-geb-project-summary-093020.pdf.

Figure 1. Rendering of OKC Federal Building

Source: GSA Region 7 Case Study Presentation

2 Project Overview

The General Services Administration's (GSA's) goal when implementing the GEB technologies was to improve overall building efficiency to lower energy consumption and power reliability and resiliency. The Federal Building is in downtown Oklahoma City, Oklahoma, and occupies 178,342 square feet. The four-story building houses several different agencies including: the Department of Housing and Urban Development, Department of the Army, Social Security Administration, and Armed Forces Recruiting, among others. The OKC Federal Building is part of a five-building retrofit that GSA performed as part of a utility energy service contract (UESC); however, this case study strictly focuses on the OKC Federal Building and the GEB technologies associated with it.

GSA emphasized the importance of implementing GEB technologies from the start of the project, looking to focus on energy efficiency, renewable energy, load flexibility, and energy storage. GSA engaged in a UESC with Oklahoma Gas and Electric (OG&E), which is different from a typical energy savings performance contract (ESPC). A UESC has more flexibility when it comes to meeting energy savings requirements. Unlike UESCs, ESPCs have guaranteed savings. With ESPCs, should an ECM fail to reach the energy service company's (ESCO's) estimated savings during annual measurement and verification, the ESCO (not the owner) is responsible to cover the financial shortfall. UESCs allow the owner to bundle added energy savings from other systems to cover the overall performance requirements. OG&E attributed much of the success of the OKC Federal Building UESC to the good standing relationship between the building owners, the ESCO, and the utility.

The project involved nine ECMs/GEB-ready technologies including a solar photovoltaic (PV) system, lighting controls, a battery energy storage system (BESS), and new heating, ventilation, and air conditioning (HVAC) controls. In total over the five buildings renovated, the project is projected to save $13.5 million over the course of the contract and account for a 41% reduction in total energy use and 3,100 metric tons of carbon reduction annually (see Figure 2).

UESC Project Highlights
$8.9 million in energy efficiency and infrastructure improvements
Year 1 cost savings of more than $412,000
41% total energy use reduction
13% total water reduction for the smart irrigation systems
Greenhouse Gas reduction of more than 3,100 metric tons/yr.

Figure 2. OG&E utility energy service contract highlights (for all five buildings in UESC)

Source: GSA Region 7 Case Study Presentation

3 Roles and Responsibilities

The project began by developing a strong team with diverse skillsets and knowledge. The design and execution of the OKC Federal Building renovation project involved substantial collaboration between team members and relied on the expertise of many different organizations. The key roles involved in the project were: GSA (the building owner), Ameresco (the ESCO), OG&E (the utility), and subject matter experts (SMEs). Internally GSA had many different teams including an acquisition team, energy and operations teams that fall under the facilities management team, and several others that supervised and provided expertise in different areas. GSA was the final decision maker and the key project manager. GSA was a strong advocate for the project from the beginning and was very enthusiastic about the GEB technologies. They coordinated project oversite and contract administration, provided existing site information, introduced partners to serving utilities, and reviewed final designs and deliverables. The OKC Federal Building project was a collaborative effort that utilized expertise from many different team members. GSA and other team members acknowledged one of the main reasons the project was so successful was the collaboration and involvement throughout all phases of the design, development, and implementation. The project team roles and responsibilities are summarized in Table 1.

Table 1. Summary of Project Team Roles and Responsibilities

Role	Overview
Building Owner (GSA)	Key decision maker and project managers/leaders Helped to develop project team Provided recommendations on technologies early in the project and provided insight on feasibility of technologies Acquisition team helped manage the contract and purchasing processes
Utility (OG&E)	Contract owner for the UESC Reviewed and approved final designs, oversaw the overall project execution, and served as liaison between the ESCO and GSA
ESCO (Ameresco)	Responsible for project development, engineering and design, contract deliverables, hiring and managing subcontractors, preparing the interconnect agreement, commissioning systems, and providing performance guarantees laid out in the UESC
SMEs	Reviewed technical aspects of technology recommendations
Tenants	Provided feedback on comfort for technologies

3.1 GSA Team

The GSA team (the building owners) were the core leaders, decision makers, and supervisors/managers for the project. The energy team for GSA was very involved in the project and essential for getting the right partners assembled. The GSA energy team provided recommendations on technologies early in the project and provided insight on feasibility and energy-related metrics to inform the overall management team about which ECMs would be the best fit for the project. In addition to the energy team, GSA also had an acquisition team to help manage the contract and purchasing processes. GSA had a specific energy acquisition team dedicated to energy related contracting. The GSA contracting officer managed the progress of the project in relation to the contract. Their main priority was to ensure everyday operations went in conjunction with the contract and to monitor any modifications that needed to be made to the contract. The contracting officer made sure that everything being done was covered in the contract and involved the legal team whenever required. The GSA Smart Buildings Program Manager gathered information and analyzed building system data to assist with the feasibility assessment for the building automation system (BAS) and controls. They worked closely with the ESCO and the controls vendors during the integration of the different systems (lighting, batteries, PV) into the BAS. The Smart Buildings Program Manager oversaw the programming of new sequences of operation for HVAC and lighting and worked to optimize the control strategies. The Smart Buildings Program Manager served as the SME on controls technologies, managed the server and the updates, and provided operational support.

3.2 Utility Team

OG&E was the utility involved in this project and was an advocate for implementing GEB technologies. They were also the contractor owner for the UESC and worked very closely with both GSA and the ESCO. OG&E attended all progress meetings, worked behind the scenes to hold the ESCO accountable (often in the context of GSA satisfying tenants), and visited the sites often to see construction and monitor site safety. OG&E oversaw many tasks including being the prime contract holder and partner with GSA, reviewing and approving final designs, overseeing the overall project execution, and being the liaison between the ESCO and GSA. OG&E was involved in the entire project and helped with anything that the government needed. According to the GSA and Ameresco the utility provided valuable and crucial insights throughout the project.

3.3 Energy Service Company

Ameresco was the ESCO responsible for project development, engineering and design, contract deliverables, hiring and managing subcontractors, preparing the interconnect agreement, commissioning systems, and providing performance guarantees laid out in the UESC. Ameresco had an appointed lead engineer and project manager for the engineering phase who managed a team of engineers that focused on the GEB technologies and the feasibility implementation. Ameresco also had an account executive who worked closely with GSA on these novel technologies to get them comfortable and answer any technical questions. Ameresco was a subcontractor to the utility; the Ameresco account executive worked with OG&E and served as the technical liaison between teams, and the Ameresco engineering team led the design. Ameresco was also responsible for performing the initial feasibility study. Their team surveyed the building systems, modeled the building, developed a feasibility study, and provided a variety of options and recommendations for implementing GEB technologies into the building.

3.4 Subject Matter Experts

GSA utilized several different SMEs both within the GSA team and externally through the National Renewable Energy Laboratory (NREL) to help make decisions and assist with the project from early contract training to technology experts. The SMEs, depending on their specific area of expertise, contributed to the project by reviewing information to ensure the technologies would seamlessly integrate into the building, analyzing life cycle data, understanding how the technologies would impact occupant comfort, and assisting with technology integration into the building. Some of the SMEs involved in the project were energy engineers, energy program managers, sustainability specialists, building automation specialists, HVAC specialists, electrical engineers, structural engineers, and several contract specialists. NREL was involved with contracting, training, and technical engineering. Some SMEs at NREL provided training and helped develop the assurance performance plan for the energy savings. Others at NREL performed a REopt analysis (an energy management and optimization platform) of the building in addition to providing technical expertise and input on the GEB technologies.[3] GSA participated in large trainings led by NREL about the differences between UESCs and ESPCs. NREL also put together trainings for the tenants and building managers.

3.5 Building Tenants

In addition to the core team members involved in executing the project, the building tenants also played a role in the process. The tenants provided feedback to the team members during the construction phase on any issues related to comfort, including airflow and lighting.

4 GEB Strategies and Technologies

4.1 Technology Selection Process

The process for identifying and implementing GEB technologies, GEB strategies, and ECMs into the OKC Federal Building began with the feasibility study. A preliminary assessment included a high-level survey of the facility to identify opportunities and energy savings by surveying the building systems and analyzing data from electrical, gas, and water bills. Based on this initial assessment and estimates from vendors, Ameresco developed preliminary cost and energy savings estimates. Ameresco then performed a feasibility study to see what technologies could potentially be installed in the building and understand the energy savings associated with the technologies. Per GSA's guidance, Ameresco started with a broad scope of potential technologies that would be narrowed down later through a screening process. After the preliminary assessment, Ameresco performed detailed audits of existing systems and modeled them using building software. Ameresco used eQUEST, a free online public open-source tool, to help model the building.[4] After the feasibility study was conducted, Ameresco presented GSA with a summary of potential ECMs that could be implemented into the OKC Federal Building and their recommendations.

Next, the ECM selection process was done collaboratively between GSA leadership and internal SMEs, Ameresco, and external SMEs. Ameresco presented a very broad range of potential technology options to GSA, including energy savings and payback periods, based on the preliminary assessment. GSA did not want to restrict the initial screening by having too narrow of a focus, so they requested a broad range of technology recommendations. The core GSA team had the final say in what technologies were going to be selected, but they valued the input from all the team members. For example, the PV array had a lot of technical details that needed to be considered, including the additional load on the roof. After consulting with structural engineers, GSA concluded that they needed to replace and refurbish the roof.

[3] National Renewable Energy Laboratory. n.d. "REopt Web Tool." Accessed December 2022. https://reopt.nrel.gov/tool.
[4] Energy-Models. 2010. "eQUEST." Accessed December 2022. https://energy-models.com/software/equest.

Payback period and cost savings were key factors in screening out technologies. Some technologies were eliminated based on cost/savings, while other technologies were not practical for the facility from a size or space constraint perspective. According to GSA, performing a cost benefit analysis while reviewing the information presented by Ameresco helped them screen out technologies. They also analyzed the life cycle of equipment and how the proposed equipment would integrate with other existing systems.

GSA sought grants and appropriated funding to supplement the project and was also able to offset some of the upfront costs by leveraging the energy efficiency rebates for selecting high efficiency products. They also received funding through a DOE AFFECT grant that allowed them to install a BESS and appropriated funding for lighting controls to achieve greater levels of demand response. These additional funding sources, although small compared to the overall contract cost, gave the project enough capital to cash flow some of the more advanced technologies. With the support of several project team members including OG&E and Ameresco (the ESCO), GSA was able to design a state-of-the-art smart building renovation that utilizes GEB technologies and ECMs to achieve their sustainability, resiliency, cost, savings, and efficiency goals.

4.2 GEB Technologies and ECMs

GSA selected eight GEB technologies/ECM strategies in addition to the new roof, as shown in Table 2. Other technologies considered that did not pass the initial screening and selection process included: ventilation systems, ground source heat pumps, and high efficiency condensing boilers. Because the utility rates are low in OKC, the payback period was not favorable enough for GSA to select these technologies.

Many of these GEB technologies and strategies contribute in one or more of the following ways to increasing grid interactivity:

- **Energy efficiency**—The ongoing reduction in energy use while providing the same or improved level of building function.
- **Load shed**—The ability to reduce electricity use for a short period of time and typically on short notice. Shedding is typically dispatched during peak demand periods and during emergencies.
- **Load shift**—The ability to change the timing of electricity use. In some situations, a shift may lead to changing the amount of electricity that is consumed.
- **Modulation**—The ability to modulate the electrical load at the sub second-to-seconds level. This enables the capability to provide small-scale, distributed grid stability and balancing services by automatically increasing or decreasing a building's power or reactive power production.

In addition, the PV system and BESS provide increased resiliency to power outages and substantial utility bill savings through on-site generation.

Table 2. ECMs Deployed in OKC Federal Building

ECM	Description	Key Benefits
PV Array	Added a 300-kW PV array on the roof of the building to capture solar energy Provides direct energy for use on site and storage through the interconnected battery system Provides utility bill reductions and increased resiliency	Generation Resiliency
Light Emitting Diode (LED) Lighting Retrofit	Previously, the building utilized older fluorescent lighting technology The fixtures were retrofitted with new high efficiency LED lighting which reduces energy and demand	Efficiency
Lighting Controls	Previously, the building did not have light controls or switches in many of the spaces Now each fixture is individually controlled in the Lutron system which dims or shuts off the lights depending on occupancy and can also be used for demand response Integrated with the BAS and BESS Provides both efficiency gains and demand responsive capabilities to shed lighting loads Reduces demand through advanced controls strategies and by leveraging the BESS	Load shedding Efficiency
Transformer Upgrades	Installed more efficient transformers so less of the energy was wasted as heat	Efficiency
BAS Upgrades	Implemented more efficient control strategies to shed and shift HVAC and lighting equipment loads Controls the ability to turn down air handling unit fans based on space requirements and occupancy	Load shedding Load shifting Efficiency
Smart Irrigation System	Installed smart irrigation controls that are used for water conservation. Before the upgrade, the system was on a timer and now the system monitors moisture levels in the soil, so it only irrigates when it is dry	Water savings
BESS	Microgrid controls with a 250-kW/500-kWh BESS interconnected with the rooftop PV system On days when it is cloudy the battery will discharge to reduce demand; used to reduce the utility bill demand charges Added resilience component to the building for back-up energy Required separate control system that needed to be integrated BESS had a longer payback period	Load shedding Load shifting Resiliency
Advanced Power Strips	Advanced power strip that can shut off computers when not in use. Strips use current sensing to reduce energy consumption.	Load shedding Efficiency
New Roof	Was not initially planned but adding the PV array required the roof to be updated	Capital upgrade

5 Implementation and Construction

After the design, planning, and selection process for the different GEB technologies, Ameresco subcontracted the work to implement and install the technologies. These subcontractors included HVAC technicians, controls contractors, solar contractors, and others involved with installation. OG&E also helped to supervise the construction and implementation to ensure all safety measures were being followed, in addition to monitoring project progress. According to OG&E, their role was to ensure the project went as smoothly as possible which involved frequent communication with the contractors on site.

The OKC Federal Building had an existing BAS that controlled the HVAC equipment, but it was not connected to the other systems (e.g., lighting, solar, batteries). During this project, Ameresco, the Smart Buildings Manager, and their teams worked together to integrate the new and updated systems under one control system. According to the team members, there were several layers of integration that the controls contractor had to tie into the BAS, but overall, it was similar to a regular construction process. They had to increase the number of supervisory controllers in the building to handle the increased amount of monitoring and data collection. The air handlers were updated with new direct digital control devices to better monitor and integrate the system. The BAS graphics were also updated to reflect the new controls.

6 Energy and Cost Savings

In the early design stages, Ameresco developed a building model and simulation tool to analyze potential GEB savings. These projected energy and cost savings estimates are shown in Table 3. After all the technologies are installed, energy and cost savings will be measured directly through the buildings BAS and submeters. Some additional submeters were installed during the project, but the site already had many in place that could be used for measurement and verification of energy savings. As shown in Table 3, the solar PV system and microgrid/BESS are expected to provide the greatest annual energy and cost savings. Overall, energy savings estimates show a total of 7,178 MMBtu and $98,822 savings for this site annually.

Table 3. Summary of ECM Energy and Cost Savings

ECM	kWh Savings	kW/yr Savings	Chilled Water MMBtu	District Steam/ Hot Water MMBtu	Total MMBtu/ Total Cost Savings	GHG MTE Savings
Lighting Controls	73,556 $3,372	0 $0	80 $756	-177 -$1,107	153 $3,021	41.1
BAS Upgrades/ Advanced Metering System	96,415 $4,419	177 $1,958	2,937 $27,889	2,110 $13,185	5,376 $47,462	1,278
Advanced Power Strips	31,100 $1,425	32 $351	0 $0	0 $0	106 $1,776	21.7
Solar PV	456,142 $22,166	229 $18,469	0 $0	0 $0	1,587 $40,635	324.6
Microgrid/BESS	-12,740 $1,806	652 $4,122	0 $0	0 $0	-43.5 $5,928	-9
Totals	**644,473** **$33,188**	**1,090** **$24,900**	**3,017** **$28,645**	**1,933** **$12,078**	**7,178.5** **$98,822**	**1,656**

7 Challenges and Obstacles

According to the team members, the OKC Federal Building project generally went smoothly and did not face many substantial issues or obstacles. There were a few challenges, however, that GSA and the other team members cited during the project. Because the OKC Federal Building is a medium-sized, isolated building in urban downtown this made planning for different options for the PV array rather limited. Also, the existing and new equipment use a variety of control systems, which proved challenging from a coordination and integration standpoint. In addition, the building had older lighting fixtures which made the lighting retrofits more difficult. For historic buildings at other sites within the project, choosing GEB strategies proved more difficult due to site and system constraints. Maintaining the overall building aesthetics was also a challenge during design and construction. Especially with technologies like the BESS which took up a large amount of space, GSA had to think of strategies to integrate the technologies with the building to ensure the building remained aesthetically appealing.

Another challenge cited by multiple team members was complying with the Buy American Act requirements for some of the materials and technologies (many of which are primarily manufactured outside of the United States). In addition, because utility rates are very low in

Oklahoma relative to the rest of the United States, payback periods were generally less favorable for advanced technologies, making the selection process more challenging.

According to multiple team members, including Ameresco and the Smart Buildings Program Manager for GSA, the controls integration process was challenging, which involves network updates, changing internet protocol (IP) addresses, and changing graphics in the system. The lighting controls system integration with the BAS was a challenge as it had a separate controls system. The overall integration was challenging because of the large quantity of systems (lighting, PV, BESS, HVAC) that needed to be updated and connected to the existing GSA system. The additional information technology (IT) security requirements for the site as a government facility added another layer of challenges for the team members involved with the integration.

COVID-19 was also cited as a challenge; although many of the team members recognized that they were fortunate with the timing, supply chain issues resulting from the pandemic still had an impact. GSA said they had fortunately ordered many of the parts and finished the preliminary phases of the project before COVID-19 emerged as a global pandemic. They were able to successfully navigate the supply chain issues that arose.

8 Lessons Learned

The team members involved in the project provided recommendations and lessons learned during the process for others looking to implement a similar project. According to GSA, they did not hire a project facilitator until construction and implementation began, and they would recommend that a project facilitator be included early on in future projects. They also described the importance of having a designated person throughout the process that is familiar with the project and can offer insight during all stages of the project. Another lesson that the GSA team learned during the process was the importance of having a technical expert to assist who can help with the controls system integration, which in this case was the Smart Buildings Manager. If there is not already a designated Smart Buildings Program Manager on site for the project, it is important to include support for this role in the contract.

The relationships between team members and ongoing collaboration/communication were also cited as a key aspect for the project's success. Strong collaboration with the utility lead and support from the field management office were beneficial, in addition to having the ESCO stay on through the entire project (and having it be the same person who was familiar with the details of the building). The utilization of GSA and NREL SMEs for reviewing different aspects of the design and implementation and providing trainings for team members in areas that were novel to some was also very beneficial (particularly for UESC requirements). The teams met on a weekly basis for most of the project timeline which was instrumental in keeping all the members involved and helped mitigate issues as they arose. It also provided the opportunity to discuss benefits of the project and ensure tenant buy-in.

The contracting officer also suggested that lot of time could have been saved during the Investment Grade Audit phase of the project if the Buy American Act material requirements were more clearly described. He recommended to include materials that are already compliant with the Buy American Act from the beginning wherever possible.

Finally, GSA stressed the importance of thinking big and keeping all technology and strategy options open in the beginning stages of the project while realizing the constraints based on payback, cost, location, and existing systems. The utility rates in Oklahoma are relatively low compared to the rest of the nation. If GEB strategies can be utilized and offer meaningful cost savings in Oklahoma, similar strategies should be replicable in almost any GSA location or environment.

9 Best Practices

The following are best practices described by GSA that were key to the success of the project:

- GSA started the project with the end goal in mind of implementing advanced GEB technologies into the building. Incorporating advanced GEB technologies into the project was a major criterion for measuring the success of the project. Early and often GSA shared this goal with the utility and ESCO to ensure expectations were clear. Placing a strong emphasis on utilizing GEB technologies and conveying the importance of the successful implementation to the project team was key to the project success.
- From the start of the project, a wide net of ECMs were pursued, including ECMs that didn’t make the final project. This allowed GSA to have many options for technology solutions that were then prioritized and chosen. Keeping a wide range of options of GEB technologies on the table was important because GSA was able to understand the advantages and disadvantages and make more informed decisions on which technologies to ultimately select.
- GSA bundled multiple buildings and ECMs together, with the up-front idea that low payback ECMs in multiple buildings would make up the difference needed for longer payback ECMs like solar and battery storage. Taking advantage of easier to install technologies with quicker paybacks can help offset the longer payback technologies and justify selection when doing a cost benefit analysis.
- GSA sought grants and appropriated funding to supplement the project. An AFFECT grant from DOE for BESS and appropriated funding for lighting controls where attained. These additional funding sources, although small compared to the overall contract cost, gave the project enough capital to cash flow some of the more advanced technologies that would not have been possible to include without these funding mechanisms.
- GSA met with key tenants early to explain the project, seek advice and recommendations, and to gain buy-in for the project outcomes. It is important to involve all stakeholders during the process to understand all perspectives and make the most informed decisions.

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