Enacting an Energy Management Lifecycle Approach in Federal Facilities

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Summary

Introduction

The building footprint of the U.S. federal government is enormous. According to the 2007 Federal Real Property Report published by the U.S. General Services Administration (GSA), federal government agencies owned, leased and otherwise managed nearly 450,000 diverse buildings that year, totaling more than 3.3 billion gross square feet. Energy is vital to the mission of each of those agencies as evidenced by the 600 trillion BTUs of energy used, at a cost of $6.2 billion, to power those buildings.

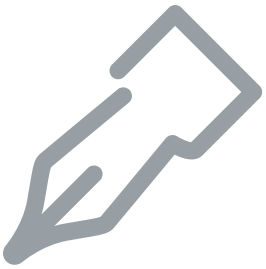
Through legislation and executive orders that have imposed stringent energy-efficiency mandates, Congress and the president have called on federal agencies to reduce the environmental impact of these buildings, curtail energy costs and help lead the nation towards energy independence and security. Government leaders recognize that a more efficient facility contributes to the sufficiency, surety and sustainability of energy supplies, and therefore, have embraced these mandates and, in many cases, established more aggressive goals. The most effective way to address these challenges and meet mandates is a lifecycle approach to energy management. Leveraging low-consumption devices, automation, control and power monitoring solutions can help ensure mandates are met and energy efficiency levels are not just maintained but continuously improved.

Such a lifecycle approach can be framed through a comprehensive energy management action plan that provides a detailed roadmap for energy efficiency improvement to manage costs, enhance energy security and reduce environmental impact over the life of the facility's infrastructure. A comprehensive energy management action plan consists of four distinct steps:

1. **Measure** energy usage data
2. **Fix the basics** by installing low energy consumption devices and addressing power quality
3. **Automate and regulate** building systems
4. **Monitor and improve** to avoid energy and cost savings erosion over time

Focusing on a carefully considered and implemented energy management action plan designed around these four steps will better position a federal facility manager to achieve ongoing energy efficiency improvements and help lead the nation towards a more sustainable future for energy and environment.

Federal Energy Legislation, Executive Orders



A key driver behind current energy efficiency initiatives is recent federal legislation and executive orders that mandate certain energy measures be taken by federal facility and energy managers. The National Energy Conservation Policy Act, signed into law in 1978, is the foundation of most current energy requirements and serves as the underlying authority for all the following acts and policies:[1]

> The **Energy Policy Act of 2005 (EPAct 2005)**, signed into law on Aug. 8, 2005, establishes a number of energy management goals for federal facility and energy managers. It sets requirements in several areas:

- **Section 103.** This section directs that an advanced electric meter be installed on all federal buildings by Oct. 1, 2012, to facilitate energy usage data, which is the first step toward lowering usage.
- **Section 104.** This section requires that each agency incorporate energy efficiency criteria consistent with ENERGY STAR[2] and Federal Energy Management Program (FEMP)-designated products for all procurements involving energy-consuming products and systems.
- **Section 105.** Energy savings performance contracts (ESPCs) are extended in Section 105 from Oct. 1, 2003 through Sept. 30, 2016. ESPCs allow agencies to pursue energy efficiency projects without upfront capital costs.
- **Section 109.** This section directs new federal buildings to be designed to 30 percent below ASHRAE (American Society of Heating, Refrigeration, and Air-Conditioning Engineers) energy efficiency standards, or those of the International Energy Conservation Code (IECC) in the case of residential buildings.
- **Section 203.** This section requires that of the total amount of electric energy the federal government consumes during any fiscal year, renewable energy consumption must meet or exceed 3 percent of that total from fiscal year (FY) 2007 to FY2009, then increase to at least 5 percent in FY2010 to FY2012 and 7.5 percent by FY2013 and thereafter.
- **Section 204.** Section 204 requires installation of 20,000 solar array systems in federal buildings by 2010.

> Additional requirements on energy intensity were included in **Executive Order (E.O.) 13423**, Strengthening Federal Environmental, Energy and Transportation Management, signed on Jan. 24, 2007. It requires federal agencies to reduce energy intensity by 3 percent each year, and 30 percent by the end of FY2015 as compared to the FY2003 baseline. It also dictates that federal agencies ensure that at least 50 percent of renewable energy required under EPAct 2005 is derived from new renewable sources.

> Another important piece of legislation is the **Energy Independence and Security Act of 2007 (EISA 2007)** signed into law on Dec. 19, 2007. As an update to EPAct 2005, it further established energy management goals and requirements for federal facility and energy managers. Its key sections include:

- **Section 431.** This section addresses energy reduction goals for federal buildings. Essentially, it codifies the intensity goals of E.O. 13423, requiring agencies to reduce energy intensity in buildings 3 percent per year, or 30 percent by FY2015 compared to FY2003 intensity levels.
- **Section 432.** This section covers requirements of facility management and benchmarking activities. It states that agencies must identify all "covered facilities" defined as a group of facilities at a single location or multiple locations managed as an integrated operation, that combine to make up at least 75 percent of the agency's facility energy use. They must perform comprehensive energy evaluations for 25 percent of those facilities each year and track implementation of cost-effective measures found.
- **Section 433.** This section directs the U.S. Department of Energy (DOE) to issue revised federal building energy efficiency performance standards within one year of EISA 2007's

1. For more, see http://www1.eere.energy.gov/femp/regulations/necpa.html.
2. ENERGY STAR is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy. For more, see http://www.energystar.gov/.

enactment. The revised standards include the provision that buildings be designed in such a manner to reduce use of fossil fuel-generated energy consumption by the percentages shown in the following table (compared with such energy consumption by a similar building in FY2003 and as measured by Commercial Buildings Energy Consumption Survey data from the Energy Information Agency):

Year	Percentage
2010	55
2015	65
2020	80
2025	90
2030	100

- **Section 527.** Finally, in a section on Office of Management and Budget Reporting, EISA 2007 directs each federal agency subject to the legislation to issue an annual report that describes the status of initiatives to improve energy efficiency, reduce energy costs and decrease greenhouse gas (GHG) emissions.

> On Oct. 5, 2009, the president signed **E.O. 13514**, Federal Leadership in Environmental, Energy and Economic Performance, which expanded performance requirements to include limits on GHG emissions. Some of its key tenets:

- Within 30 days, federal agency heads must designate a senior management official to serve as Senior Sustainability Officer accountable for agency conformance. This job includes setting agency-wide FY2020 targets for reduction of GHG emissions.
- In relation to GHG management, it states that within 90 days, each federal agency must establish and report a FY2020 percentage reduction target of agency-wide scope 1 GHG emissions (i.e., all direct GHG emissions) and scope 2 emissions (i.e., indirect GHG emissions from consumption of purchased electricity, heat or steam) in absolute terms relative to a FY2008 baseline. Within 240 days they must establish and report the same for agency-wide scope 3 GHG emissions (i.e., all other GHG emissions).
- E.O. 13514 also lays out requirements ensuring that all new federal buildings are designed to achieve zero net energy by 2030 through the implementation of high-performance design, construction, operation and management, maintenance and deconstruction. Net zero energy use essentially means a building produces as much energy as it consumes.

+ Case Study: Air Force Medical Service

The U.S. Air Force Medical Service (AFMS) provides medical service to 2.63 million eligible beneficiaries, including active duty personnel, family members and retirees at 62 campuses nationwide, including hospitals, medical centers and clinics. In 2005, with its energy bills topping out at $39 million, and the recently passed Energy Policy Act of 2005, it was clear that energy management measures needed to be implemented.

It came in the form of an extensive power metering project that the AFMS commissioned with Chicago-based Kroeschell Engineering, designed to ascertain energy usage across the breadth of its facilities. Utilizing more than 100 Square D® PowerLogic® ION power meters from Schneider Electric enabled AFMS to capture information on all utility usage resulting in numerous benefits. Energy usage information can be accessed daily by Kroeschell and AFMS engineering personnel via the Internet, providing an accurate snapshot of dozens of facets of energy usage, which can suggest areas that require attention. Of course, energy savings translates to cost savings, which benefits local facility budgets and programs as well.

“Air Force Medical Service wanted a central clearinghouse for collection of the energy data and a consistent yardstick used to compare its facilities to similar-use facilities,” says Ken Schuette, vice president of Kroeschell Engineering. “For instance, electric and gas meters were read monthly, but in many cases, there were no water meters, so water billing had to be allocated. They really wanted to establish consistent, accurate and reliable water, air, gas, electric and steam, or WAGES, metering.”

Funding Sources

Finding the necessary capital to comply with the various federal legislative energy requirements is another challenge federal facility and energy managers face. Appropriations have historically been insufficient. Although the American Recovery and Reinvestment Act (ARRA, also known as the economic stimulus package passed by Congress in February 2009) provides some supplemental funding, it does not close the gap between investment needed to meet all federally imposed mandates and the available funds. This has driven demand for alternative financing methods, like ESPCs, utility energy service contracts (UESCs), power purchase agreements (PPAs) and energy incentive programs.

An **ESPC** involves a partnership between a federal agency and an energy service company (ESCO) to design and execute a "paid for by savings" infrastructure improvement project that requires no upfront capital cost. The ESCO provides an energy audit, identifies areas of improvement, and then, in consultation with the agency, designs, constructs and maintains the energy conservation measures that fulfill its recommendations. It also arranges financing, while guaranteeing that the improvements will generate enough cost savings to pay for the project over the term of the contract.

Evidence of ESPC success is shown by the number of contracts already completed, and the savings attained. According to FEMP, more than 460 contracts have been awarded by 19 different federal agencies in 47 states. This translates to $2.3 billion invested in federal facilities, with savings of more than 18 trillion BTU annually, and $7.1 billion in energy cost savings ($5.7 billion to finance the projects and $1.4 billion in net savings).

UESCs are another means offered to federal agencies to help implement energy efficiency projects with no initial capital investment required. In a UESC, the servicing utility arranges financing to cover project costs, which are subsequently repaid over the contract term from cost savings generated by the energy efficiency measures. Similar to an ESCO, the utility essentially provides one-stop shopping for energy solutions and champions a comprehensive approach that bundles short- and long-term payback improvements to maximize the efficiency and resulting savings.

The contracting process for UESCs and ESPCs can be time consuming. To streamline the process and save time and money during the contracting process, agencies can leverage Indefinite Delivery, Indefinite Quantity (IDIQ) contracts that have been established with either their utility, called an Area Wide Contract (AWC), or with ESCOs, like the DOE ESPC IDIQ. Additionally, if an AWC is not in place, UESC contracting can be streamlined through a Basic Ordering Agreeement or Model Agreement.

PPAs provide financing specifically for on-site renewable energy projects. Under the terms of a PPA, a developer will install a renewable energy system on agency property, with the agreement that the agency will then purchase the power generated over the life of the contract as payment. The system is actually owned, operated and maintained by the developer, eliminating potential operation costs for the agency in the form of maintenance. PPAs also provide the ability to monetize renewable energy tax incentives.

There are also numerous **energy incentive programs** available at the state level to help federal facility and energy managers offset energy costs. Typically, the programs are either energy efficiency/renewable energy programs, or demand response/load management programs. Energy efficiency/renewable energy programs fit into three basic categories:

1. Public purpose programs administered by utilities, state agencies or other third parties.
2. Utility programs administered by the local utility.
3. Programs sponsored by state agencies that are designed to promote energy efficiency and renewable energy.

FEMP Guidance and Opportunities

FEMP serves as a facilitator for federal agencies in the implementation of cost-effective energy management and investment practices. It helps federal agencies develop and implement sustainable design, operation and maintenance practices that incorporate energy efficiency, renewable energy and water-conservation technologies for both new construction and retrofit projects, as well as transportation management. FEMP's services include energy audits, operations and maintenance assessments, laboratory design protocols, new technology reports, advanced metering and transportation management assistance.

FEMP provides numerous guidance documents on federal laws and regulations, as well as specific guidance pertaining to a number of energy technologies to assist energy managers in complying with energy management requirements and reaching their energy goals.

In addition, FEMP supports federal agencies during the funding process, offering assistance in identifying and obtaining ESPCs, UESCs, PPAs and other energy incentive programs. It also offers Decision Support Services to help federal agencies gain compliance with all applicable requirements regarding energy and water efficiency, renewable energy and fleet management.

In 2008, FEMP provided technical assistance that resulted in renewable energy sources of 159 GWh of wind power and 135 GWh of renewable energy certificates. Also in 2008, FEMP compiled a comprehensive report on requirements of E.O. 13423, in its *Annual Report to Congress on Federal Government Energy Management for FY 2007*. A noteworthy finding of this report was first-year results of new renewable energy goals as stated in EPAct 2005 and E.O. 13423. Federal agencies reported purchasing or producing 2,774.0 GWh, or 4.9 percent of goal-eligible renewable electric energy in FY2007 – well surpassing the goal of 3 percent.

Furthermore, in its *2008 Year in Review*, FEMP cites initial findings on investment potential and benefits already reported based on evaluations submitted by agencies on June 30, 2009. Among the most popular potential efficiency investment opportunities were electric motors and drives, lighting improvements, building automation systems and advanced metering systems. Some of the highlights include:

- 773.5 million square feet evaluated, 25 percent of total square feet
- $5.3 billion in potential project investment identified
- 27.7 trillion BTU in potential energy savings (8 percent from current levels)

Meeting Mandates for Existing Facilities

The sheer size of current U.S. federal government building holdings provides enormous opportunity for application of energy efficiency measures in those existing facilities. A lifecycle approach requires careful consideration and planning, and increases the opportunity for a successful energy management program.

There are two basic types of energy management measures for federal facility and energy managers to consider: passive and active. **Passive energy management** is the deployment of basic energy-efficient end-use devices and actions. Typical measures include installation of energy efficient light bulbs and motors, improving a building's power factor, fixing compressed air leaks, and installing better insulation and windows. Conversely, **active energy management** comprises ongoing, persistent and permanent changes achieved through measurement, monitoring and control of energy usage. Many of the systems that consume energy can utilize automation and control to optimize energy usage and help ensure that cost savings don't erode over time.

The following chart illustrates the differences between passive energy efficiency measures and their active counterparts.

Passive	Active
High-efficiency lighting	Lighting control, occupancy sensors
Energy-efficient motors	Variable speed drives for motors
High-efficiency boilers	Software and metering to track energy usage to key loads or processes
HVAC equipment	Building automation system to control HVAC
Energy efficiency of individual components and systems	Energy management system (EMS)

A carefully constructed energy management action plan incorporating both passive and active measures can help federal facility and energy managers hone best practices to reduce energy and lifecycle costs. While there are many ways to improve an existing facility's energy efficiency by varying degrees, including passive and active measures, the overall goal should be continuous improvement. Without a well-defined, strategic plan, implemented tactics likely won't achieve their full energy and cost savings potential.

Case Study: Camp Pendleton

Located between Los Angeles and San Diego, CA, U.S. Marine Corps Base Camp Joseph H. Pendleton is basically a small city. It is America's busiest military base, home to the 1st Marine Expeditionary Force, 1st Marine Division, and host to 60,000 military and civilian personnel each day. Camp Pendleton covers nearly 200 square miles and includes 6,000 buildings and 15.3 million square feet of office space.

Faced with the challenge to reduce baseline energy consumption levels to meet legislative and executive mandates, Camp Pendleton placed a heavy emphasis on their lighting and implemented a comprehensive retrofit plan. The plan included replacing existing lighting with higher-efficiency luminaries and incorporating Square D lighting controls to switch lights off during unoccupied periods. Square D® Powerlink® lighting control systems were installed with each system, including independently configurable time schedules and the ability to configure up to 64 lighting zones per controller, in order to best meet occupant needs and provide flexibility.

Jeff Allen, Base Energy Manager, states "Lighting control represents a straight-forward way to reduce energy consumption. It reduces energy use, prolongs lamp life, reduces maintenance costs, contributes to our energy reduction goal and creates a pressure-free environment for personnel, because lights go off on their own."

By mid-2006, after several phases of the project that commenced between 2003 and 2005, base energy consumption reduced 31 percent from 1985 levels. With savings over 500,000 kWh annually, the payback period has been better than originally expected.

The most effective plans comprise four basic steps:

Step 1: Measure. The first step entails collecting data from major energy consumers and analyzing their impact on total consumption. For example, installing a power metering and monitoring system in a federal office building or a U.S. military base is crucial to establishing an energy usage baseline for those facilities and their governing agencies.

Step 2: Fix the basics. Fixing the basics typically consists of efforts like installing low energy-consumption devices, such as high-efficiency lighting, HVAC systems and motors, or improving a building's power factor. While they can translate to substantial savings, such measures are typically a one-time improvement, or a passive approach to energy management.

Step 3: Automate. Ongoing energy efficiency improvements can be achieved by automating and regulating building systems. Measures like schedule-based lighting control and occupancy sensors automatically turn lights on only when they are needed, while HVAC control regulates heating and cooling at optimal levels, which can change day by day. These measures facilitate an active approach to energy management because they can be adjusted based on new energy-efficiency opportunities that arise in the future.

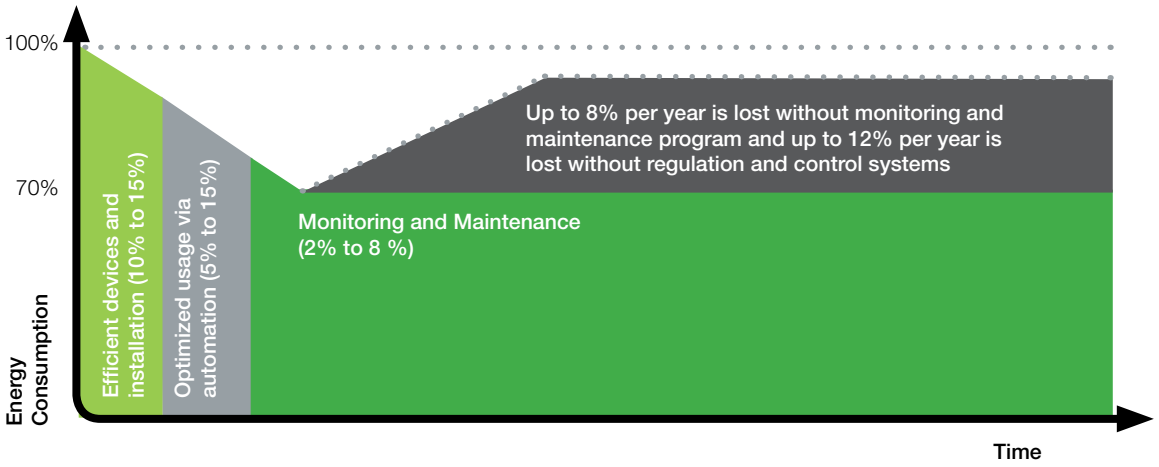
Step 4: Monitor and improve. An energy management action plan also helps ensure that initial energy and cost savings don't erode over time and can continuously be improved. Power meter installations, monitoring services, energy efficiency analysis, regular maintenance and recommissioning, and implementation of an energy management system (EMS) can all help achieve continuous improvement.

The Importance of an EMS

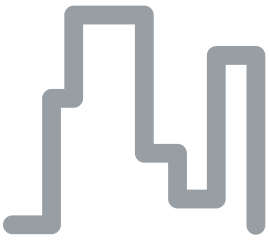
Essentially, an EMS collects energy-relevant data, such as water, compressed air, electricity, natural gas and steam values, operational requirements and outside air temperature. That information is then collated and presented as actionable business intelligence in a dashboard format that can be customized for an individual users' needs. The information an EMS provides can be studied to find new ways to better manage energy usage, troubleshoot existing energy challenges and quantify payback on energy efficiency measures that are implemented. In addition, an EMS can be integrated with a control system to actively monitor and manage a dynamic, diverse group of loads to maximize efficiency and make the most of demand response programs.

Savings Potential

Federal facility and energy managers that commit to a lifecycle approach to energy management comprised of an energy management action plan can realize up to 30 percent savings in a relatively short duration. Value is realized in these areas: efficient devices and installation (10% to 15%), automation and controls (5% to 15%), and monitoring and maintenance (2% to 8%). It's important to note that without a monitoring and maintenance program or regulation and control systems, up to 20% of these savings per year can be lost.



Meeting Mandates for New Facilities



In addition to existing buildings, it's also important to apply sustainable technologies and design practices to new federal facilities.

There are federal guidelines for sustainable building design and operation strategies for energy efficiency, environmental stewardship and conservation, all geared toward the construction of sustainable or "green" buildings. Most notably, these guidelines come in the form of the *Whole Building Design Guide (WBDG)*.[3] The *WBDG* was first conceived in 1997, by a combination of federal agencies led by chairman of the Sustainable Buildings Industry Council (SBIC), Don Prowler. Since then, it has become the primary Web-based source for engineers and architects to gain access to relevant and timely information on a varying array of buildings-related guidance, criteria and resources.

Some key tenets of the *WDBG* include:

- Establishing, at a minimum, sustainable design goals equivalent to the silver certification level of the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Green Building Rating System™
- Putting together a multi-disciplinary design team with all building stakeholders
- Developing a whole-building design that integrates architectural and engineered features
- Evaluating lifecycle costs in all design and financial decision making

Additionally, FEMP contributes to this effort with its Business Case for *Sustainable Design in Federal Facilities*. This report outlines the many benefits of sustainable design, including lower energy costs, reduced operating and maintenance costs, less pollution, a better image and more.

The GSA has also demonstrated a commitment to sustainable building design. In 2001, GSA was the first federal agency to join the U.S. Green Building Council, and continues to be very active. To date, through its Design Excellence Program, the GSA boasts numerous successes in its own facilities, including a 30 percent energy usage reduction and 12 percent less cost than private sector buildings, along with achieving LEED status in 24 buildings in six years.

The GSA lists five goals it seeks to achieve in its commitment to sustainable design:

1. Using an integrated team approach to design, construct and operate its buildings.
2. Reducing the total lifecycle ownership cost of facilities.
3. Improving energy efficiency, water conservation and reducing material consumption.
4. Providing safe, healthy and productive built environments.
5. Promoting excellence in environmental stewardship.[4]

3. For more information, see http://www.wbdg.org/.
4. For more information on the GSA's findings and commitment to sustainable design, please read Sustainability Matters, which can be found at www.gsa.gov.

Conclusion

Federal facility and energy managers are simultaneously facing multiple energy-related concerns. Increasing costs are cutting into their operating budgets. Federal legislation is constantly evolving and mandating that their facilities become more energy efficient by set percentages in defined timeframes.

Enacting an energy management lifecycle approach to address these concerns will reap significant benefits – especially when one takes into account the federal government's massive building footprint. It can significantly reduce the environmental impact of 450,000 buildings, curtail energy costs by billions of dollars, reduce dependence on foreign oil and help ensure the surety, sustainability and sufficiency of energy to carry out their missions.

Implementing an energy management action plan, including measuring, fixing the basics, automating, and continuous monitoring and maintenance, helps ensure goals and mandates are met, and maximum results are achieved.

Using alternative funding options like ESPCs and UESCs provide an efficient framework to tackle comprehensive energy projects. Agencies like FEMP and GSA offer numerous forms of assistance, such as guidance documents and project transaction services. Suppliers like Schneider Electric are also equipped to streamline product and technology procurement processes when working with federal agencies and contracts. For example, the company's General Services Administration (GSA) Multiple Award Schedule (MAS) Contracts streamline the procurement process by offering pre-negotiated prices, thus reducing administrative time in addition to cost. Likewise, Schneider Electric's IDIQ contracts, such as the Utility Monitoring and Control Systems III contract through the U.S. Army Corps of Engineers and the DOE ESPC IDIQ contract, are ideal vehicles to reduce procurement time and cost.

Ultimately, energy efficiency is no longer an option for federal facility and energy managers – and to that end, energy management isn't either. Fortunately, the ability to achieve both is within reach right now, in order to meet federal mandates, reduce costs, decrease environmental footprint and enhance security. Moreover, it allows the federal government to take the lead in this all-important equation and be an example for the nation.

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