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Energy as a Service

A Cost-Effective Path to Energy Resilience for the Federal Government

by Kevin Vaughn

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Introduction

Executive Summary

Energy as a Service (EaaS) presents a new model of energy delivery and management that can provide the U.S. federal government with significant energy, operations, and financial benefits. Federal agencies are facing ever-increasing challenges that come with complex energy environments, demanding energy management requirements, outdated systems and equipment, and rising energy costs. An EaaS approach offers a comprehensive and holistic service that manages everything from energy delivery and infrastructure to financing and ownership. This white paper defines EaaS, delves into its benefits, and shows how efficiently and cost-effectively installation performance goals and requirements can be met.

Today, energy resilience, supply, management, and assurance are top concerns within the U.S. federal government, especially for the U.S. Department of Defense (DoD) and its military branches. Ensuring continuity of operations amidst rising energy costs, compliance with government mandates, and the continual threat of cyber attacks, natural disasters, and adversarial risks has become more and more challenging.

One emerging business model that can help the military branches overcome these challenges is Energy as a Service (EaaS). Navigant Research defines EaaS as "the management of one or more aspects of a customer's energy portfolio – including strategy, program management, energy supply, energy use, and asset management – by applying new products, services, financing instruments, and technology solutions."

As the term implies, an EaaS initiative allows the DoD's military branches and other federal agencies to purchase everything associated with the management of their energy needs **as a service**. Typically, EaaS is a contractual agreement paid for via an annual service fee and delivered from a single source that oversees all aspects of the engagement through service agreements with a consortium of one or more parties.

This evolving, innovative concept can help military installations more effectively and cost-efficiently fulfill their mission while minimizing energy-related security and operational risks. As an example, the U.S. Air Force spends a significant $5.5 billion on energy annually to power its missions while attempting to achieve ambitious energy resilience and assurance goals. The Air Force is exploring how EaaS can optimize, and perhaps even reduce, this investment as it faces increasingly complex energy environments, demanding energy management requirements, outdated systems and equipment, rising costs, and disjointed acquisition approaches.

The primary deliverables of EaaS

Military installations recognize energy management is not a core competency and that they can benefit from the expert oversight an EaaS model provides in managing part or all of their energy portfolios.

An EaaS initiative is set up to provide military bases three core deliverables (Figure 1):

1. Energy delivery

When energy is delivered as a service, it helps installations obtain the energy they need to meet resilience, demand, and assurance goals as they consolidate siloed energy delivery into a holistically managed delivery model. To help achieve energy efficiency and conservation goals, an EaaS model combines traditional energy solutions with cost-effective and energy-saving microgrid-controlled distributed energy resources (DER) such as solar, wind, and energy storage that are typically implemented on premise.

2. Energy infrastructures

An EaaS agreement also provides federal agencies with all the systems and services for the development, operational management, and ongoing maintenance of new innovative high-efficiency technology. The systems may include DERs, microgrids, electrical substations, switchgear, and data center equipment. It can also include the modernization of existing systems, as well as plans for future continuous improvement and ongoing security assurance. In addition, EaaS provides the technology and systems to support and validate cybersecurity, cyber survivability, and operational resilience requirements for all energy, technology, and operational systems throughout an installation.

3. Financing and ownership options

Navigant Research notes that financing innovation is fundamental to EaaS as it enables new business models and the delivery of energy options that offer OPEX benefits and relieve CAPEX constraints. Therefore, key to this service are third-party financing and asset ownership that alleviate the pressure on a federal agency's energy-related expenditures, time, people, capital resources, and risk mitigation.

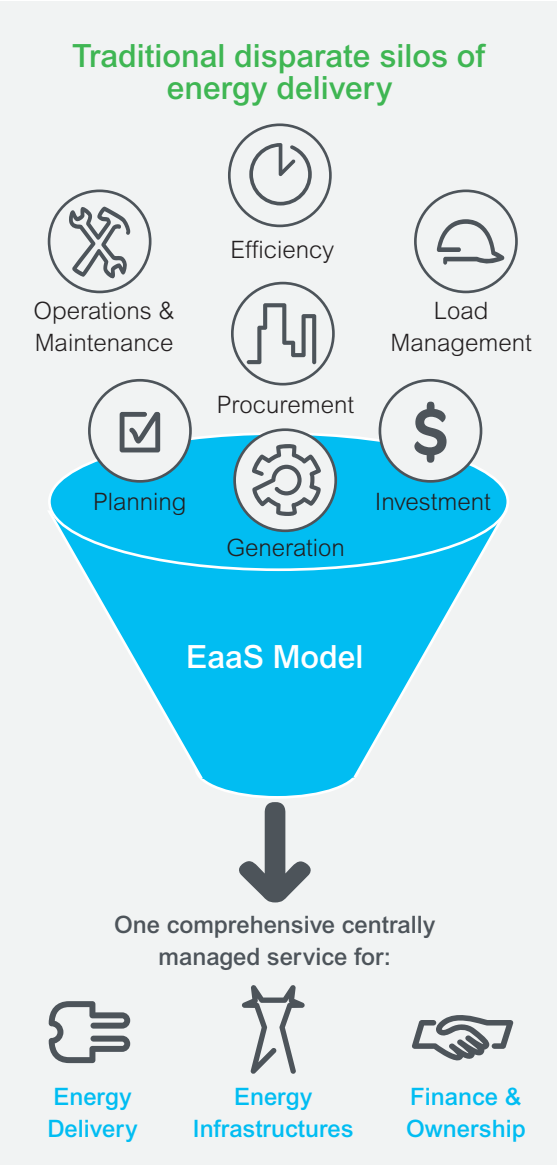

Figure 1: *EaaS consolidates disparate traditional energy delivery into a comprehensive managed service.*

Easing the burden of managing energy

The stated vision of the U.S. Air Force for EaaS is a partnership with industry suppliers "to buy the capability, not just the commodity" in order to "ensure power when, where, and how it's needed so airmen can focus on the mission." And that is exactly what EaaS can provide (see Figure 2).

According to Energy as a Service Market: Global Forecast until 2023, the EaaS market is experiencing rapid growth because this model is delivering highly attractive benefits. With the implementation of EaaS, organizations can reduce operating costs, improve energy efficiency, install innovative energy equipment, and optimize energy supplies.

For military installations, the expected outcomes of an EaaS strategy go even further. For instance, one DoD branch anticipates that an EaaS model could deliver on-base electric utility systems and the procurement of supply while implementing energy conservation measures. And it is exploring how an EaaS business model could provide an integrated, holistic energy assurance plan that eliminates costly silos, leverages expert industry resources, and takes advantage of attractive energy efficiency incentives.

Besides providing a single source of energy assurance to power mission-critical installations with more resilient, cleaner energy, EaaS initiatives can also provide the DoD with attractive third-party financing and incentive options. These opportunities supplement and complement appropriated funds, resulting in considerable cost savings with no capital outlay.

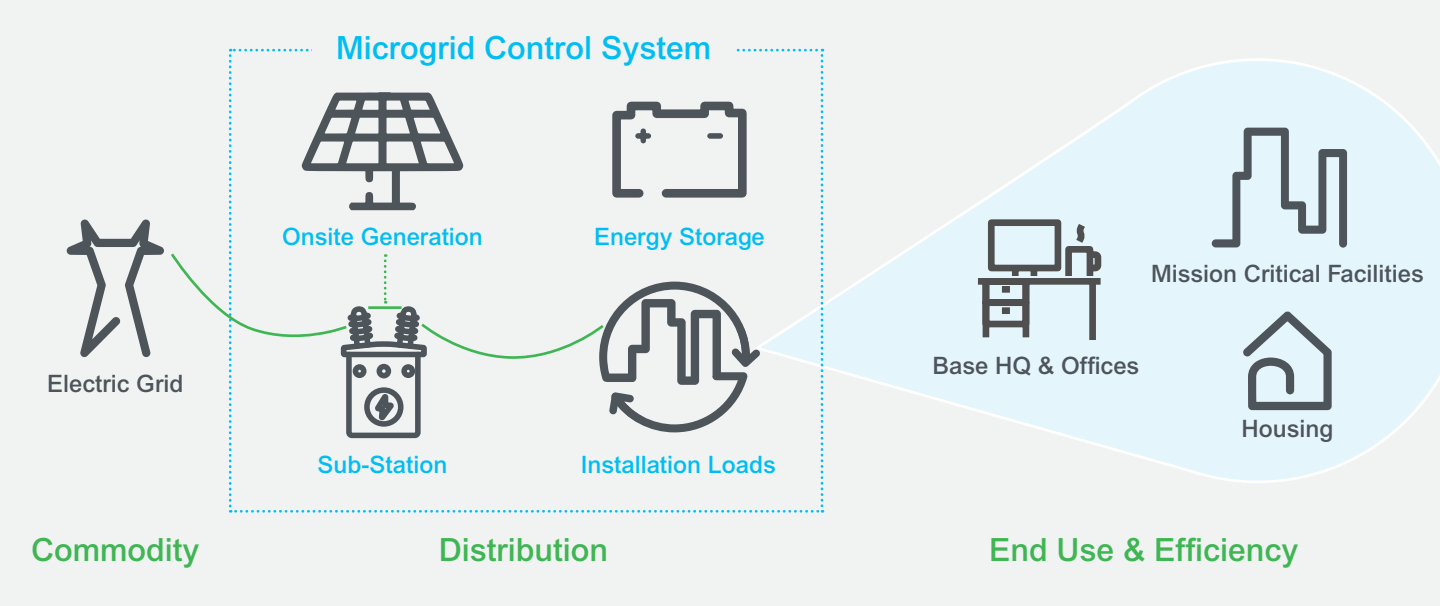

Figure 2: *EaaS includes everything from the energy generation of electric grids to delivery that supports an entire installation.*

The specific benefits — and the associated outcomes — of an EaaS model will vary, depending on a military installation's goals and objectives. However, here are some common ones that an installation could expect to achieve:

Table 1

EaaS Benefits and Outcomes	
ENERGY DELIVERY Resilience, assurance, and efficiency	• A single, holistic source for all energy delivery and services • A combination of traditional energy efficiency solutions with distributed energy resources such as solar and wind • Industry expertise with strategic insights and customized program development • Strategic procurement • Assured energy supply energy conservation and efficiency • Continuous improvement
ENERGY INFRASTRUCTURE Development, modernization, management, security, and maintenance	• Innovative new systems and technology for energy delivery, efficiency, and conservation • Modernization of systems and equipment • Development of DER resources • Scalability for future expansion and growth • Cybersecurity technology, policies, and methodologies for IT and operations • Ongoing operations management, system upgrades, and maintenance • Performance guarantees for increased uptime, response time, and redundancy
FINANCING AND OWNERSHIP Financing, management, and funding resources	• Energy delivery for a fixed, guaranteed yearly fee • Third-party ownership and management of energy systems and assets • Reduced operational costs and risks due to performance guarantees • Federal, state, and local energy incentive programs • Third-party funding options to supplement appropriated funds • Little to no capital investments

Typical benefits and outcomes of an EaaS strategy

A high-level view of an EaaS business model and delivery

As mentioned earlier, EaaS is often delivered through a consortium or joint venture that includes specialty vendors that partner with federal agencies to deliver energy and provide all the equipment and services needed. The consortium also assists with financing and ownership options in addition to providing and meeting performance guarantees for energy supply and resilience. Typically, the consortium partners include energy services companies (ESCOs), utility privatization organizations, operations and maintenance (O&M) contractors, general design and build contractors, and financing firms.

Here is a quick look at the overall EaaS business model and the implementation steps an agency would take, along with a description of the partners involved and how they would work with an installation.

1. Define specific energy assurance and resilience requirements

Federal agencies with missions that are vital to the safety of the United States are required to address the risk of energy disruptions through threat assessments and specific strategies. According to the DoD, these strategies include the development and implementation of a plan for replacing and improving emergency power generation readiness, thus reducing system maintenance. They also include improving fuel flexibility to ensure the sustainability of all emergency power generation systems in operation.

Therefore, the first step in EaaS is to review the energy-related requirements that result from such a risk assessment and determine specific installation energy goals, performance requirements, and objectives. These are typically unique and varied per base. For instance, one installation may need new or modernized energy systems while another may be better served by integrating its existing energy systems through a centralized microgrid.

It's important to delineate each goal and the anticipated benefits in order for an EaaS business model to be competently developed. To assist with this, an ESCO can conduct an energy assessment to help determine, based on its current state of energy readiness, what initiatives an installation should undertake to meet its required goals. During such an engagement, the need for DER solutions, such as solar PV, wind, natural gas-fired distributed generation, and demand response resources can be evaluated. In addition, the benefits and needs associated with load management and optimization, microgrid controls, energy storage, cybersecurity, and building management systems can be assessed as well.

2. Develop a plan that will deliver the desired results

To realize the full benefits of EaaS, there will be a need for a variety of services and equipment. The services would include everything from engineering, project management, financing, and construction services to hardware and software solutions for energy generation and distribution. Here are some typical components of an EaaS plan:

- Engineering analysis and design of requirements, equipment, and systems.
- Engineering services for electrical distribution systems, energy and power management systems, and energy efficiency.
- System integration services and equipment for integrating monitoring, control, communications, and automation systems into green-field and brown-field applications.
- The development of load shed and load preservation, system monitoring, control and ongoing operations, and maintenance plans.
- The implementation and delivery of supervisory control and data acquisition (SCADA) systems, demand side management (DSM) systems, microgrid controllers, electrical infrastructure equipment, and intelligent forecasting and optimization solutions.
- The design, installation, and operation of appropriate cybersecurity solutions for both industrial controls and IT environments.
- The incorporation of various distributed energy resources, including solar and electrical energy storage as well as more traditional generation typologies.
- Metrics for measuring the achievement of energy goals.

3. Select a team of consortium partners

To deliver the elements of the above plan, several specialized partners would be included in an EaaS consortium or joint venture. Here is a look at the typical partners and what their roles would be:

An energy services company (ESCO)

Generally, an ESCO is the consortium's prime contractor and managing partner, and as the primary point of contact (POC), is responsible for the long-term strategic management of the EaaS agreement. ESCOs are typically prequalified and highly experienced to deliver some form of EaaS (without asset ownership) through previously established contract vehicles with the DoD.

An ESCO takes the lead for "pay-from-savings" projects, utilizing vehicles such as energy savings performance contracts (ESPCs), energy sales agreements (ESAs), and energy-related incentives that help fund EaaS deliverables. An ESCO also explores initiatives like demand optimization and response, energy generation, and resilient operations. In addition, an ESCO recommends, where appropriate, projects such as upgrading systems and technologies with innovative new solutions, or the modernization of existing ones to take advantage of sustained efficiency improvements and long-term cost reductions. Agencies also look to an ESCO to provide services and equipment related to cybersecurity.

An ESCO typically supports consortium partners with auditing, energy analyses, commodity procurement, microgrid control of resilience operations, measurement and verification (M&V) of contract performance, third-party financing, and long-term strategic energy resilience planning and execution.

Utilities privatization (UP) companies

These local or regional organizations provide power, gas, water, and wastewater services. They identify where resilience-focused and other utility system deficiencies can be improved. They also often provide ownership, operations, and maintenance of energy infrastructure through UP agreements. These organizations may support an ESCO with new energy generation and distribution, demand response programs, and procurement of utility and other incentives where regulatory and legislative authority allows.

Energy providers and utility companies can ensure grid-based energy supply and other off-site utility distribution and supply resilience. They also often participate in strategic energy resilience planning with the ESCO and other key partners.

Operations and maintenance (O&M) contractors

As qualified vendors for O&M services, these partners are responsible for the ongoing operation and maintenance of buildings, plants, and energy resilience systems that are not provided by the UP partner. They take the lead for resilience-focused operations services under the umbrella of a performance-based scope that is established to achieve and maintain energy resilience deliverables within a specific contract period. This includes operations and maintenance of resilience measures for onsite power and energy generation, emergency power generation, energy distribution, and microgrid controls where applicable.

These partners perform facilities-oriented O&M to sustain demand optimization and efficiency measures per the EaaS contract and any requirements for ESPC or ESA agreements. They also act as facilities managers for mission-critical installations served by the contract while supporting an installation's energy manager in overall program execution. They are, of course, part of any strategic energy resilience planning initiatives.

General design and build contractors

These vendors would be involved in strategic energy resilience planning and execution and are qualified to deliver design and build services for energy plants, distribution systems, and other large-scale, energy- or facility-related projects. They also design and implement resilience-oriented repair and replacement measures in coordination with an O&M contractor where appropriate.

Financial partners

As appropriate, various third-party financing partners and organizations that provide federal, state, or local incentives would be included as a consortium contributor. The ESCO would manage or offer these services for the installation.

4. Generate a modular and scalable delivery model

Once the partners in the consortium have been identified, service level agreements (SLAs) are developed for the contractual delivery of services based on each desired outcome. ESCOs typically take full responsibility for the delivery of the desired outcomes as the project lead. They would assign roles and tasks to each consortium member associated with the delivery of state-of-the art equipment as well as engineering, construction management, and guaranteed performance services.

Here is an example of what that might look like.

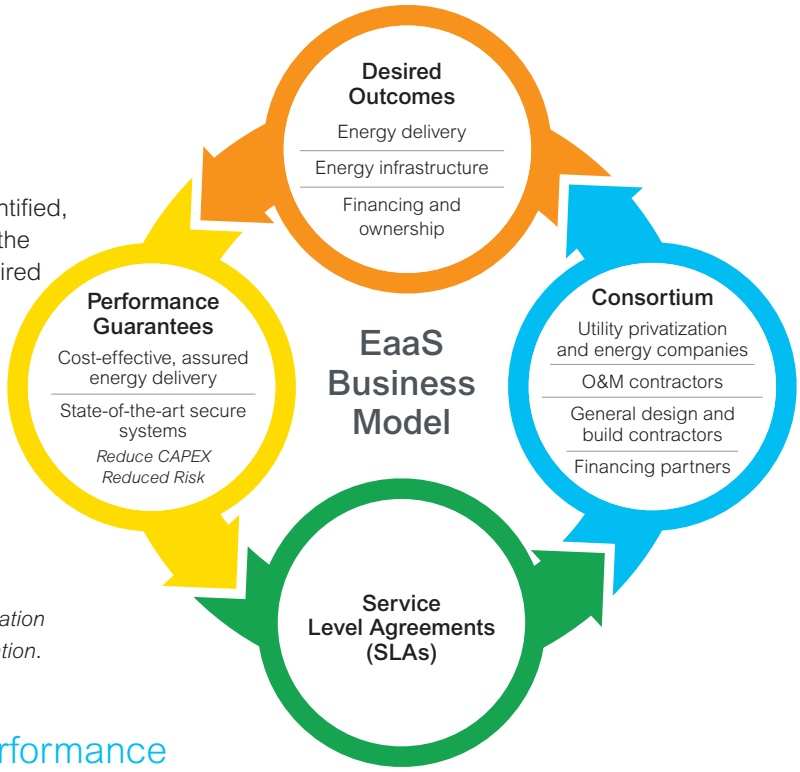

Figure 3: *EaaS includes everything from the energy generation on electric grids to delivery that supports an entire installation.*

5. Define metrics for guaranteed performance

In a typical EaaS agreement, the consortium manages the risk of rising energy costs and provides a fixed yearly adjusted fee for the unit cost, annual energy usage, and savings, along with certain guaranteed performance metrics. The metrics include requirements such as guaranteed uptime for mission-critical equipment and systems.

As an example, a provider could include a guarantee for comprehensive operations, maintenance, repair, and replacement (OMR&R) of critical equipment for a 20-year performance period. Oftentimes, this could include onsite full-time employees and a rapid response guarantee to ensure optimal and sustained performance of mission-critical resources.

6. Identify financing and ownership options

EaaS initiatives may require multiple sources of public or private financing, depending on asset ownership, contract vehicles used, and available appropriated resources. The consortium's lead identifies the best financing options as well as available federal, state, and local incentives.

Cost savings from energy management initiatives, along with state and local incentives, can be combined with alternative funding contracts to significantly reduce the financial burden on a military base. These programs not only provide the necessary funding for energy resilience, but they also inherently build the cornerstones of an energy resilience program in and of itself. For instance, several energy management initiatives could result in building a microgrid, which could save a single military base anywhere from $8 to $20 million over the microgrid's 20-year life span.[1]

Here is a quick overview of some financing options:

- There are a variety of funding sources, such as tax credits, rebates, and incentives available for energy savings, including renewable energy credits or certificates (RECs). Utility companies also provide cost-saving incentives for installation of energy-efficient equipment and conservation projects.
- The DoD and other agencies can use innovative funding sources such as energy-related contracts that they are already familiar with for EaaS. Besides ESPCs and ESAs that were mentioned earlier, there are also options such as: utility energy service contracts (UESCs), enhanced-use leases (EULs), utility privatization (UP), and power purchase agreements (PPA) that provide private funding for resilience.

Under some of these contracts (such as UP, EULs, and ESAs), the consortium could take ownership of energy generation and distribution assets through long-term leases, transfer, or conveyance of real estate property.

To learn more about these financing options, please see Beyond Appropriated Funding: An Innovative Financial Equation for Building Energy Resilience.

Footnote: 1. "U.S. Military Could Save Over $1 Billion and Boost Energy Security, New Research Finds," The Pew Charitable Trusts, January 2017

Examples of EaaS in action

Energy cost-saving infrastructure improvements:

Naval Base Coronado and Naval Base San Clemente Island Naval Stations, California[2]

This use case depicts how the desired outcomes of EaaS — reliability, sustainability, resiliency and efficiency — can be achieved. The project also includes an example of how an EaaS initiative can be funded through resources and contracts like ESPCs, along with what the guaranteed savings that come with EaaS would look like.

The Naval Base Coronado (NBC) and Naval Base San Clemente Island (NBSCI) sites initiated a comprehensive ESPC-funded infrastructure improvement project. The improvements will generate $114 million in guaranteed energy cost savings over the 19-year project term. The project is helping the U.S. Navy meet many of its short- and long-term strategic energy program goals, including resilience and sustainability.

This extensive project encompassed upgrades to 90 buildings, including a large data center and electrical upgrades, as well as renewable energy and traditional energy conservation measures. The project is increasing the resilience, reliability, and capacity of mission critical facilities, reducing overall operational and maintenance costs, and adding renewable sources to the Navy's energy portfolio.

The project addressed facility challenges, such as aging infrastructure and rising overhead costs, along with government mandates, which are essential to the maximum efficiency of these sites. A key component of the project includes upgrades to the Grace Hopper Service Center at NBC, one of the Navy's mission-critical facilities. Through this project, the Navy consolidated several data centers and improved the security of information stored and disseminated at the facility through greater reliability. The project also reduced power usage effectiveness (PUE) from 2.53 to 1.2 and lessened consumption of server floor area from 60% to 20%, making room for new IT equipment with built-in redundancy.

The upgrades helped the Navy dramatically improve the reliability of these mission-critical sites.

This Schneider Electric project was completed in 2018.

Energy consumption reduction and renewable energy:
The United States Coast Guard Sector San Juan, Puerto Rico[3]

This use case also shows how the outcomes of EaaS can be delivered with the use of ESPC funding and financing through an ESA.

In 2010, the U.S. Coast Guard (Coast Guard) addressed rising fuel prices and poor grid reliability in Puerto Rico through an ESPC. The financial burden and need to increase energy security were the main drivers for the implementation of multiple energy conservation measures (ECMs) in over 300 buildings on the Puerto Rico installation.

The project resulted in building automation system (BAS) optimization, installation of variable refrigerant flow/volume (VRF/V) cooling units, improved indoor air quality, lighting retrofits and controls, building envelope improvements, water conservation, and renewable energy systems.

A renewable ESA was implemented for this project, which enabled various tax incentives based upon third-party ownership of the renewable energy assets to reduce the cost of the project. Under this ESA, Schneider Electric, as the ESCO, maintains and guarantees performance of the photovoltaic systems owned by a third party, capturing and passing along financial benefits to the Coast Guard.

The Coast Guard purchases the electricity generated by the solar systems at a fixed, escalated rate over 23 years. This allows the installation to consume renewable power at a predictable price, below what they were paying for "brown power," without having to purchase or maintain the renewable energy systems.

Through the ESPC, the Coast Guard receives the advantages of energy savings, reduced maintenance, improved occupant comfort, and enhanced reliability.

"Within the Coast Guard, this project is significant not only because of its scale, but also because of its scope," said Daniel Gore, former program manager for the U.S. Coast Guard Energy Program.

"By targeting renewable energy installations, infra-structure upgrades, and energy conservation measures, the Coast Guard has successfully combined innovative technology with reduced maintenance burdens – an ideal project model."[4]

The 3 megawatts of distributed solar photovoltaic systems are generating 4,185,830 kWh per year, exceeding the guaranteed savings of the ESPC by almost 5%. This translates to nearly $1.1 million in energy production. All other ECMs are combining to achieve a verified $877,287 in annual utility savings. At the time of implementation, this project was the largest photovoltaic endeavor pursued by the Coast Guard.

This project received the following awards:

- DOE – Federal Energy and Water Management – Outstanding Project
- DHS – Green Innovation Award Winner
- DOE – Presidential Award – DHS Nominee
- NAEP – National Association of Environmental Professionals – Nomination for Environmental Excellence Award

Schneider Electric completed this project in April 2012.

Footnote: 3. "United States Coast Guard Implements Milestone Energy Savings Project with Schneider Electric," Schneider Electric, 2014

4. "U.S. Coast Guard Finds Success with Collaborative Funding Method for Renewable Energy Project," Renewable Energy World, November 2011

Energy security microgrid: Marine Corps Air Station, San Diego, California[5]

This final use case shows how the desired outcomes of an EaaS strategy can be delivered to address energy security, mission critical resilience, and long-term sustainability.

The Marine Corps Air Station (MCAS) Miramar in San Diego, California is building a microgrid to enhance its energy security. Once fully operational, the microgrid will include a total of five distributed energy resources (DERs) that provide resilience and incorporate renewable energy, landfill gas (LFG) energy storage[6], and demand side management. The microgrid allows allow operations at all of the installation's mission-critical facilities to continue uninterrupted if the utility power grid is compromised or damaged.

The project design is scalable to potentially power the entire installation and will also help reduce utility demand charges by facilitating demand response programs, incorporating renewable resources and advanced smart grid control systems to enable better management of energy loads throughout the installation.

Construction includes the build-out of a new, fully-permitted 7-megawatt (MW) diesel and natural gas-fired power plant, updates to the energy control systems, and the refurbishment of an existing building into an advanced energy and water operations center (EWOC). The EWOC provides plant operators and base energy personnel with direct control of the integrated microgrid and utility control system. All elements of the system have been designed and built in compliance with DoD security infrastructure and risk management requirements. Redundant controls are also provided for additional energy security.

The microgrid at Miramar will power more than 100 mission-critical facilities during a utility grid outage, including all flight line operations. It integrates existing power generated from renewable energy sources, including 3.2 MW of converted local landfill methane gas, 1.3 MW of solar photovoltaic generation, and LFG energy storage for standard operations.

The initial microgrid project, awarded July 2016, was implemented through a joint venture between Black & Veatch and Schneider Electric. The energy storage and demand side management expansion awarded to Schneider Electric is scheduled to be completed in 2019.

Conclusion

Energy as a Service can help alleviate the mounting pressure associated with energy resilience that federal agencies face today. The comprehensive end-to-end nature of EaaS can save time and resources while improving energy delivery, efficiency, and security. With a consortium of qualified partners, federal agencies can rest assured that EaaS is one of the best ways they can support their mission-critical roles in serving their government.

About the author

Kevin Vaughn is the ESPC Program Director at Schneider Electric. Mr. Vaughn has nearly 30 years of experience working in the energy industry and has developed over 35 comprehensive Energy Savings Performance Contracts (ESPCs) in his career. Several of these ESPC's include EaaS such as the Naval Base Coronado and U.S. Coast Guard- Puerto Rico projects.

Footnote: 5. "Black & Veatch and Schneider Electric to design and build microgrid at Marine Corps Air Station Miramar," Black & Veatch and Schneider Electric, July 2016

6. Schneider Electric Selected to Perform Microgrid Expansion at Marine Corps Air Station Miramar, Schneider Electric, February 2019

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Corporate Knights, 2017

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