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Deep Energy Retrofits in Federal Buildings: The Value, Funding Models, and Best Practices

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INTRODUCTION

Deep energy retrofits (DERs) can accelerate our transition to a clean-energy future. DERs directly address the gargantuan energy consumption of existing buildings and can be implemented today without relying on radical technologies or untested methods. In the United States, buildings consume almost 50% of all energy and account for about 45% of carbon dioxide (CO_2) emissions, making buildings the largest end-use energy sector, followed by industry and transportation (Architecture 2030 2013). Buildings' enormous appetite for electricity—most of which is produced by fossil fuels—threatens our climate, our security, our economy, and our health. More than 80% of existing buildings today are at least 15 years old (EIA 2012), indicating that existing building retrofits represent a significant opportunity in the transition to a low-carbon future.

Because saving energy is typically far cheaper than generating it, eliminating buildings' energy waste by aggressively deploying energy efficiency is one of the most cost-effective paths to a resilient and clean-energy future. Deploying DERs, which typically achieve at least 50% savings beyond baseline energy consumption using integrative, whole-building design principles, is a key part of the solution.

In the United States, the federal government is the single largest landlord, controlling over 400,000 owned or leased buildings, which comprise over 3 billion square feet of space (GSA 2016a). Federal agencies are currently driven to comply with several energy policies, primarily Executive Order 13693, a directive that outlines energy and water efficiency goals, including net zero energy targets (White House 2015). Despite the call for building energy reductions, federal funding for building upgrade projects (including energy projects) is insufficient to meet these needs, and this trend is expected to continue. Federal agencies must carefully consider alternative financing options and effectively use appropriated funding that may be available.

Alternative financing mechanisms, such as energy savings performance contracts (ESPCs, the alternative financing mechanism focused on in this paper) and utility energy savings contracts (UESCs), are critical to agencies' abilities to achieve comprehensive energy savings with limited funding. At their core, ESPCs allow agencies, in partnership with energy service companies (ESCOs), to finance the up-front costs of energy-savings and facility-improvement projects through their energy savings. This approach requires no up-front capital costs or special appropriations from congress (DOE 2016a). The energy (and sometimes maintenance) cost savings from these measures are captured by the ESCO and used to pay back the initial cost of implementing the measures. When appropriated funding is available, it can pay for energy projects directly but can often drive greater value by being incorporated into existing ESPC projects.

Several pioneering agencies, including the U.S. General Services Administration (GSA), the U.S Army (within the U.S. Department of Defense), and the National Aeronautics and Space Administration (NASA) have led the federal government toward deep retrofits using ESPCs. To maximize energy and carbon reductions from federal energy efficiency projects, lessons from leading agencies need to be adopted broadly, a long-term approach needs to be taken toward building energy management, and agencies need to explore blending different

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funding methods in a way that can increase and enhance the value of planned retrofit projects.

This paper aims to guide federal energy managers and decision makers, contractors (including ESCOs), engineers, and other stakeholders in federal energy projects toward a set of solutions, including DER best practices and guidance to maximize combined funding that will allow federal agencies to achieve federal energy mandates and support their missions in a cost- and resource-efficient manner using DERs. This paper may also be of interest to building owners; general contractors; design, architectural, and engineering firms; and manufacturers of energy-efficient products and systems. The paper assumes familiarity with federal ESPCs; those who are unfamiliar with federal ESPCs can learn more at the page on energy savings performance contracts for federal facilities on the energy.gov website (EERE 2016).

THE VALUE OF DEEP ENERGY RETROFITS TO THE FEDERAL GOVERNMENT

What is a Deep Energy Retrofit?

A deep energy retrofit (DER), as defined by the International Energy Agency's Annex 61, is "a major building renovation project in which site energy use intensity (including plug loads) has been reduced by at least 50% from the pre-renovation baseline with a corresponding improvement in indoor environmental quality and comfort" (IEA forthcoming). A DER can span multiple phases of renovation to better align with key building milestones, in which case a performance baseline (based on utility data or a calibrated model) must be established by the owner and/or the energy service company (ESCO) at project onset to measure the cumulative energy savings. In the framework of a DER, an integrative and whole-systems approach should be used to select and evaluate bundles, or packages of energy conservation measures (ECMs), rather than considering individual technologies in isolation. By considering ECMs as part of a bundle, the interactive effects between ECMs can be leveraged, enhancing energy and capital cost savings opportunities in turn. DERs, though often more expensive up front, deliver substantially greater value than short-term, shallow renovations or projects intended to fix immediate issues. DERs deliver sustained energy and cost savings by leveraging the history, current condition, and future of a facility to deliver a thoughtful and economical approach to energy savings.

What is the Value of a Deep Energy Retrofit?

Deep energy retrofits can provide direct value by reducing energy consumption and operating costs and can provide indirect value by reducing carbon emissions, making progress toward policy goals, and making buildings more valuable, comfortable, productive, and healthy. Some of these values are easy to quantify, while others can be considered added benefits.

Direct Cost Savings. Direct cost savings are most often attributed to reductions in energy costs, which are typically on the order of a 50% or greater energy cost reduction from the baseline for a DER. DERs also typically drive significant operations and maintenance (O&M) cost savings. The U.S. General Services Administration (GSA) has reported maintenance costs approximately 12% lower than industry averages in post-occupancy surveys of 22 of its "green" buildings (Fowler et al. 2011). Capturing O&M savings as part of a federal energy savings performance contract (ESPC) project can enable a larger scope and greater energy savings, but doing so remains a challenge (this topic is explored further in the subsection entitled "Include Occupant Behavior and Operations and Maintenance Savings").

Indirect Cost Savings. Deep retrofits can also result in measurable but indirect cost savings or new operating income. DERs often result in reduced vacancy rates due to greater occupant satisfaction, which the GSA has reported as 27% higher than national averages in post-occupancy surveys for its green buildings (Fowler et al. 2011). Additionally, insurance companies have recently begun rewarding green buildings with reduced premiums, citing the assertion that commissioning and sustainable design reduce sick building syndrome claims and may also reduce damage claims from both human and natural hazards (Nalewaik and Venters 2009). Many projects have also reported better building utilization (i.e., an increase in leasable space) as a result of downsizing their mechanical systems as part of a DER. For example, the deep retrofit of the Deutsche Bank Twin Towers in Frankfurt, Germany, freed up an entire building story to be used as newly leasable space (Designalmic 2013).

Deep energy retrofits also bring a host of secondary benefits that are more difficult to quantify but can result in indirect cost savings. These include productivity increases, increases to health and wellbeing, recruiting advantage and greater employee retention, and property value increases, among others (Bendewald et al. 2014).

While these benefits are challenging to quantify and cannot always be counted as financeable cost savings, they should still be promoted and considered as added benefits in a DER project. Figure 1 estimates the positive impact that some of these direct and indirect values, beyond energy cost savings, can have as the result of a DER.

Supporting Policy Mandates for Energy and Greenhouse Gas Emissions Reductions. It is important to consider a DER as a dynamic strategy for helping the federal government meet sustainability goals and mandates. Federal agencies are tied to key federal mandates that call for enhanced energy efficiency, carbon reductions, and resilience to climate change and natural disasters. Executive Order (EO) 13693, *Planning for Federal Sustainability in the Next Decade* (White House 2015), calls for consistent energy and water use intensity reductions through 2025, an increase in renewable energy production, new net zero buildings (for buildings that enter the planning process after 2020), and net zero energy and water targets for existing buildings. These policies reinforce and extend the provisions included in the Energy Independence

POTENTIAL VALUE BEYOND ENERGY COST SAVINGS

Maintenance Costs	Pacific Northwest National Laboratory (2008); Leonardo Academy (2008); Aberdeen Group (2010)	↓	9.0-14%
Occupant Satisfaction	GSA (2011)	↑	27-76%
Rental Premium	Eicholtz, Kok & Quigley (2010); Wiley et al. (2010); Fuerst & McAllister (2011); Eicholtz, Kok, et al. (2011); Newell, Kok, et al. (2011); Miller, Morris & Kok (2011); Pogue et al. (2011); McGraw Hill/Siemens (2012)	↑	2.1-17%
Occupancy Premium	Wiley et al. (2010); Pogue et al. (2011); McGraw Hill/Siemens (2012)	↑	3.14-18%
Property Sale Price Premium	Eicholtz, Kok & Quigley (2010); Fuerst & McAllister (2011); Eicholtz, Kok, et al. (2011); Newell, Kok, et al. (2011)	↑	11.1-26%
Employee Productivity	Lawrence Berkeley National Laboratory	↑	1.0-10%
Employee Sick Days	Miller, Pogue, Gough & Davis (2009); Cushman & Wakefield et al. (2009); Dunckley (2007); City of Seattle (2005); Romm & Browning (1995)	↓	0-40%

* Information courtesy of Rocky Mountain Institute's Deep Retrofit Value Practice Guide.

Figure 1 *The direct and indirect cost savings of a DER estimated based on industry reports and studies (RMI 2015c).*

and Security Act of 2007 (EISA) and are further reinforced by the goals in President Obama's Presidential Performance Contracting Challenge (PPCC). The PPCC calls for federal agencies and their ESCO partners to deliver over $4 billion in ESPC value by the end of 2016 (DOE 2016b) and has been a driver of many new ESPCs over the past few years. DERs, especially those executed using ESPCs, allow agencies to pursue these goals while ensuring that each dollar spent on an energy efficiency project goes further.

Supporting Agency Missions. Deep energy retrofits help agencies to directly support their missions and to indirectly support them by being responsible stewards of federal taxpayer money. DERs reduce agency operating budgets and allow them to focus funding toward directly addressing their missions. Missions can also be supported more directly by DERs:

- The U.S. Department of Defense (DoD) improves energy security and resilience by reducing energy loads and using solar in place of fossil fuels, which often need to be transported in potentially vulnerable convoys.
- The GSA increases workspace utilization while still driving higher tenant satisfaction.
- The U.S. Department of Veterans Affairs offers more satisfying and healthy spaces with enhanced indoor air quality, greater access to natural light, and other DER benefits.
- Agencies are increasingly calling for enhanced resilience, which can include load reduction and renewable energy supply.

Replacing Aging Infrastructure and Improving Building System Reliability. By engaging in a DER, large building systems are often replaced with new, high-quality,

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right-sized equipment. Rather than reacting to equipment failures or waiting for appropriations, agencies can proactively replace equipment nearing the end of its life, reducing the risk of equipment and facility downtime (which can hinder productivity or interrupt agency missions).

Increasing Resilience. In the wake of major natural disasters such as Hurricane Katrina and Hurricane Sandy and an increasing awareness of the threats that global climate change poses to national security, resilience has become a key concern of the federal government (Donovan 2015; DoD 2015). *Resilience* in this context refers to the ability of federal infrastructure, including building energy systems, to continue serving mission-critical operations when natural disasters, security risks, or other threats arise. Resilience has been the core focus of many policy mandates, directives, and studies affecting the federal government in recent years (White House 2013a, 2013b; National Academies 2012). These policies call for improved "environmental performance," which includes energy efficiency and renewable energy generation as key pathways toward more resilient federal facilities, with the added benefit of saving taxpayer money through reduced operating costs while improving energy and water security (White House 2015). Increasing the depth of energy savings and environmental performance directly supports greater resilience for federal facilities.

Hedging Risks Associated with Energy Cost Volatility. Deep energy retrofits can help agencies hedge the risks related to rising or otherwise volatile fossil fuel energy costs. The World Energy Council's *World Energy Issues Monitor 2016* (WEC 2016) cites that "commodity prices and associated volatility have replaced energy prices as the number one critical uncertainty on the energy agenda for leaders and experts globally" (p. 6). Fluctuating fossil fuel prices and long-term uncertainty about the costs of coal, oil, and natural gas expose utility customers, including government agencies, to significant potential price fluctuations. This exposure can be limited by reducing energy consumption as a result of on-site load reduction (i.e., DERs) and by producing on-site renewable energy, both of which allow agencies to exert more control over their energy supply.

Maximizing the Value of Federal Appropriations. Developing a DER drives a greater bang for the buck on federal energy projects. Even though an ESPC does not typically use federal appropriations to pay for any of the project's capital expenditures, federal appropriations are used to fund the federal employees who serve as project managers, contracting officers, or facility representatives or serve in other roles for each project. These resources are essential to bringing about ESPCs for a given agency, and their funding often limits the number of ESPC projects that an agency can pursue at one time. Driving the deepest energy savings possible in an ESPC project drives the greatest financial and carbon-reduction return on the taxpayer money used to fund these federal project management resources.

FUNDING DER PROJECTS

DER projects in the federal government are typically funded in three ways: appropriated (public) funding; performance contracting, such as ESPCs and utility energy savings contracts (UESCs), which are forms of private funding; or combined funding, which is a combination of public and private funding.

Appropriated Funding (Public Funding)

Appropriated funding comes from the United States Congress and represents an allocation of congressional discretionary funding for agencies' approved budgets. Government agencies have limited appropriated funds to renovate existing buildings, whether to repair aging infrastructure, update building interiors, plan for disaster preparedness and resilience, or perform energy upgrades. Agencies typically have some funding available for building improvements under programs like the DoD's sustainment, restoration, and modernization (SRM) program, but it is not often enough funding to retrofit a significant portion of an agency's portfolio on its own.

Federal buildings benefited greatly from appropriations delivered under the American Recovery and Reinvestment Act of 2009 (ARRA). ARRA awarded $5.5 billion to the GSA and $7.4 billion to the DoD for the construction and renovation of buildings for energy efficiency improvements and other modernization efforts. ARRA resulted in many impactful projects, including the GSA's net zero energy retrofit of the Wayne N. Aspinall Federal Building and U.S. Courthouse (Chang et al. 2014). However, appropriated funding for building modernization and energy efficiency projects has been significantly less prevalent since ARRA.

Performance Contracting (Private Funding)

Performance contracting, typically delivered in the form of ESPCs or UESCs, allows federal agencies to deliver energy savings without special appropriations from Congress. Project costs are financed by a third party and paid back over time based on the expected energy savings of the project. The structure of ESPCs is explored in more detail in the Introduction and in Figure 2. Performance contracts have been essential to enabling agencies to achieve the aggressive energy efficiency targets laid out in EO 13693 and EISA and will be essential to continued progress as buildings move toward greater levels of efficiency and net zero energy.

Combined Funding (Public and Private Funding)

Applying appropriated funding to ESPC projects as a one-time payment (attributed to a cost avoidance) can improve the economics by reducing the total cost to be financed. This allows the project to include longer-payback measures, increasing the amount of energy savings and infrastructure renewal that an ESPC would achieve beyond a project without the one-time payment. For some agencies, like the DoD, this appropriated funding must be designated solely for energy-related projects

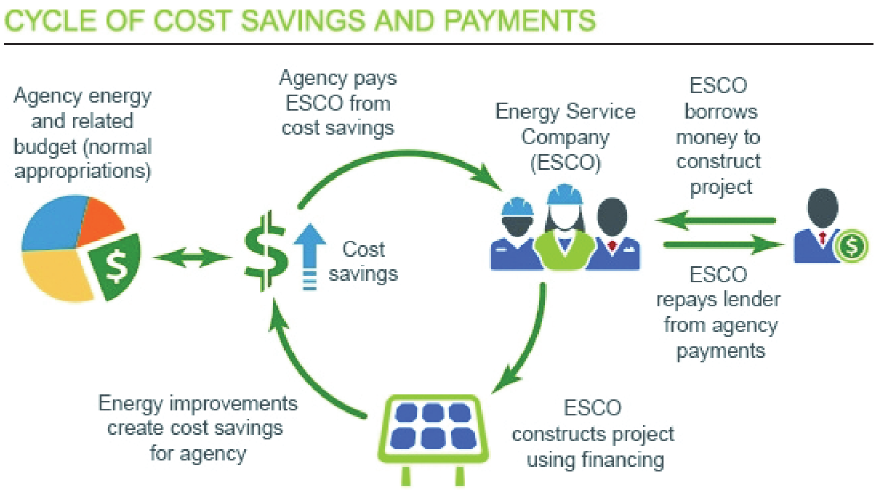

Figure 2 *A typical federal ESPC project structure (EERE 2016).*

before being used as supplementary ESPC funding. There is a long history of agencies using appropriated funds, including energy-designated DoD SRM funds, as one-time payments in ESPC projects. There is often a strong argument for applying these funds to drive greater project value, but the legal limitations of combined funding models must be considered. Combined funding models are explored in detail in the subsection entitled "Combine ESPC and Appropriated Funding to Drive Projects Deeper"

GSA'S NATIONAL DEEP ENERGY RETROFIT PROGRAM

The GSA is the landlord of the civilian federal government, with over 8000 assets totaling almost 375 million square feet of rentable space (owned and leased), most of which is office space (GSA 2016b). The GSA has the third-largest real estate portfolio and has the fifth-largest primary energy consumption of all federal agencies (EERE 2011). Like any large portfolio manager, the GSA faces several issues related to its large, aging building stock. Many buildings are old and have issues such as high energy consumption, a need for space repurposing, low employee density and underutilization, poor indoor air quality, and deteriorating building infrastructure. In order to address these deficiencies, as well as comply with federal mandates on energy use and carbon reduction, the GSA decided to launch a program focused on driving deeper energy savings, the National Deep Energy Retrofit (NDER) program.

GSA NDER Approach

In August 2011, the GSA launched the NDER program to demonstrate deep energy savings delivered through ESPCs. The NDER program is now the GSA's sole ESPC delivery mechanism, and the program's objectives exemplify DER best practices while clearly articulating the GSA's intent to drive deep energy savings through these longer-term projects (RMI 2015b):

1. Move federal facilities towards net zero energy consumption.
2. Reduce water consumption at federal facilities.
3. Implement cost-effective retrofits with payback periods of 25 years or less.
4. Complete associated construction work without major tenant disruption.
5. Use innovative technologies.
6. Use renewable energy technologies.
7. Use comprehensive and integrated whole-building approaches to determine ECMs.

The first round of the NDER program (which took place 2012–2014) resulted in 10 ESPC task orders with a total investment value of $172 million, distributed among seven ESCOs in six GSA regions. This represents retrofits in 13.1 million square feet of space across 21 buildings. The result is a 365 billion Btu energy consumption savings per year and a guaranteed cost savings of $10.8 million per year, which will be used to pay back the investment value for each project over an average contract term of 19 years (with project contract terms spanning 12–23 years). Round 1 of NDER projects resulted in a 38.2% average project energy savings, including one project expected to achieve net zero energy, which is double the 19% savings from other federal ESPC projects during a similar time period (Shonder 2014). The energy savings of the NDER Round 1 projects are summarized in Figure 3.

Round 2 of the NDER program kicked off in May 2014, and many Round 2 projects are at the end of the ESPC development cycle. To date, two Round 2 task orders have been issued and the GSA expects several more to be issued by the end of 2016. Based on the success of Round 1 and the good progress of Round 2, the GSA is currently planning a third round of the program.

BEST PRACTICES: BUILDING ON DER SUCCESSES

The GSA, the Army, and other federal agencies have seen success in pursuing DERs using ESPCs and have standardized a set of best practices with the hope that they will become standard operating practices for federal ESPCs and other federal energy projects. The best practices summarized in this section resulted from an in-depth look at a number of federal DER projects (RMI 2015a; Shonder 2014). Many of these best practices are simple in theory but require dedication and diligence to implement. The best practices in this section are intended to complement, rather than replace, existing resources like the ESPC best practices provided by DOE's Federal Energy Management Program (FEMP) (FEMP 2016).

Preplanning and Project Initiation

Centralize Resources and Streamline the ESPC Process. Agencies should create a central contracting team within the agency to manage and oversee the process, like the GSA's Program Management Office (PMO). The PMO was established to standardize and streamline the ESPC review and award process, which previously had been managed by individual GSA regions. Centralized and consistent technical, contracting, and legal advice likely influenced the regions to accept more comprehensive projects, leading to correspondingly higher levels of savings. The PMO established a common timeline for the award process and provided guidance to regional offices on pricing, financing, engineering, and contracting. The PMO also benefited ESCOs, because having a knowledgeable and experienced project partner makes the process smoother and simpler, reducing project risks and timelines. By establishing the PMO, the GSA achieved a significant reduction in project cycle time, awarding the 10 NDER Round 1 Task Orders in an average of 15.9 months (after ESCO selection), compared with an average of 20.9 months for projects from other federal agencies awarded during a similar time period (Shonder 2014).

The standard practice in other agencies varies significantly. Several ESPC leaders, like the Army, have their own centralized offices to gain similar efficiencies and consistency in developing ESPC projects. Small or under-resourced agencies should consider working collaboratively with each other to pool resources and/or with agencies that have centralized and successful ESPC programs (e.g., GSA, Army, Defense Logistics Agency [DLA], and FEMP) to leverage and build upon their successes.

Select Ripe Opportunities for Deep Retrofits. Agencies should time ESPCs or other retrofit projects to occur in tandem with triggers such as planned building renovations (for aesthetic, energy, or disaster-recovery and resilience purposes) or with the end of useful life for major building equipment (e.g., HVAC equipment) (RMI 2016). The King and Brickell Federal Buildings' ESPC was timed with planned HVAC equipment replacement, allowing for the ESCO to downsize new HVAC equipment by 8% and for the GSA to contribute $2.2 million in appropriated funding toward the ESPC (RMI 2015a). Combining projects and replacing equipment on a schedule can save project costs and time, reduce facility downtime, and add energy benefits to a planned project within a building's life cycle. This concept is explored in more detail in the subsection entitled "Achieve Deep-Over-Time Energy Savings."

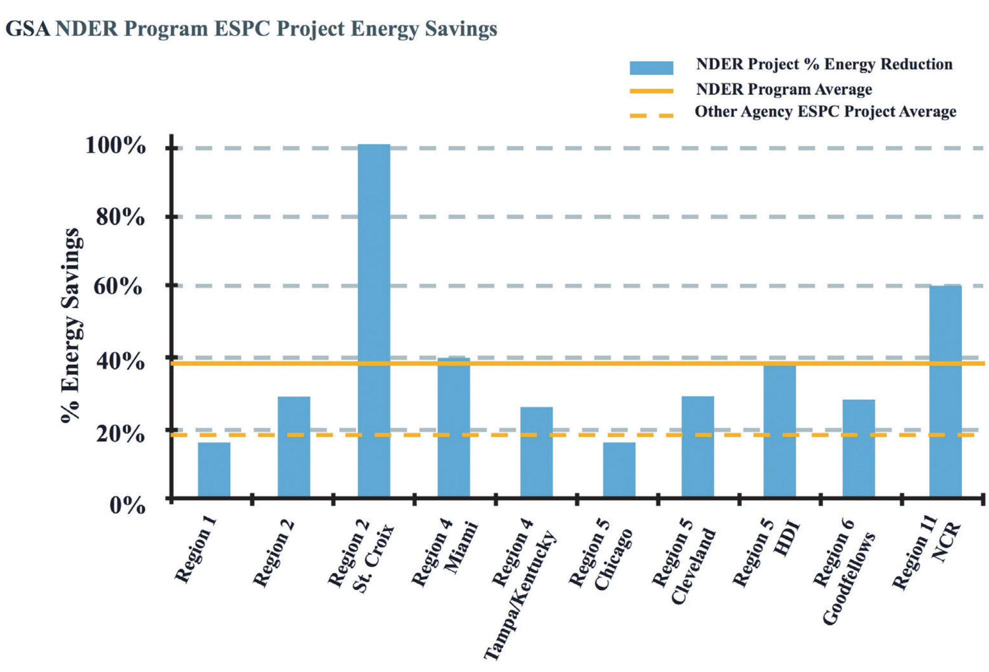

Figure 3 *Energy savings by project for the GSA NDER program (RMI 2015c).*

Notice of Opportunity and Contractor Selection

Manage Risk During Selection. Agencies should avoid extending contractor competition (and higher perceived risk) far into project development. It is recommended that agencies attempt to downselect to a single ESCO after a qualifications-based notice of opportunity (NOO) response rather than engage in a competitive preliminary assessment (PA) where several ESCOs deliver preliminary assessments. Although greater competition can be perceived as delivering better results, a fair, qualifications-based process that downselects to a single ESCO for the PA can unencumber the selected ESCO, which no longer feels the need to hedge the development risk of not moving forward to the investment grade audit (IGA) and task order (TO) award. This has the added benefit of reducing agency review time and shortening the procurement timeline (Shonder 2014).

Set Clear and Aggressive Long-Term Energy Goals from the Outset. Agencies should reinforce project energy reduction goals (and other goals, like water reductions) with clear targets. These goals can take many forms, but energy use intensity (EUI, a measure of energy consumption per square foot of building space) or total building energy consumption are recommended as clear and measurable targets. Setting goals and demonstrating that agency leadership supports these goals will often instill ESCO confidence in aggressive project goals and yield more creative results. It is crucial that the full life cycle of the building, including long-term maintenance considerations and planned change of use, are considered when developing these goals. For example, the Army has seen deeper energy savings as a result of its net zero (energy, waste, and water) installation goals. At Fort Buchanan, an installation with net zero energy and water goals, a multiphase ESPC has resulted in 53% energy and 70% water savings, with continued progress expected in the future (RMI 2015a).

Preliminary Assessment and Investment Grade Audit

Engage All Stakeholders Early and Often. ESCOs and agencies should work together to engage the proper stakeholders early and often. This should begin with a collaborative stakeholder mapping exercise in which the ESCO and agency determine which agency personnel need to be involved or informed during key processes, reviews, and decisions throughout the project. Then, the ESCO should kick off the project with a collaborative design charrette that assembles all stakeholder groups—from the agency decision-makers, legal and procurement personnel, and facility management personnel to site personnel such as occupant representatives and O&M staff—who could provide a balanced perspective of the site's needs. The personnel types shown in Figure 4 should be considered for such events. The key goal of the design charrette is to clearly define project roles, responsibilities, desired outcomes, concerns, and recommendations. This should be followed by open communication between the ESCO and appropriate personnel throughout the PA and IGA phases of the project. The better informed stakeholders are, the more supportive they will be, especially when taking on the new concept of a DER.

Both agency and ESCO personnel should also utilize the project contracting officer, technical resources, and FEMP's project facilitators and project executives. These resources should drive the ESCO and the agency toward the best holistic and deep energy solution for the building.

Audit and ECM Development that Supports Integrative, Holistic Design. ESCOs should expand their PA audits to uncover a building's maximum energy savings potential, and agencies should support a PA report that offers deeper energy savings than what is expected from an average ESPC project. ESCOs can propose deeper energy savings by looking beyond surface-level building potential—they should consider the ages, conditions, and capacities of building systems in addition to the energy interactions between these systems.

An integrated approach can uncover interactive system energy and capital cost savings by first considering load reduction strategies then bundling them with equipment replacement and downsizing opportunities to drive capital cost savings, increase system efficiencies, decrease O&M costs, and compound energy savings. Considering these measures as part of a bundle (rather than as stand-alone measures) will demonstrate the true value that these measures bring in combination. For example, with the New Carrollton Federal Building ESPC, the ESCO uncovered significant load reduction opportunities early in the project, including the retrofit of

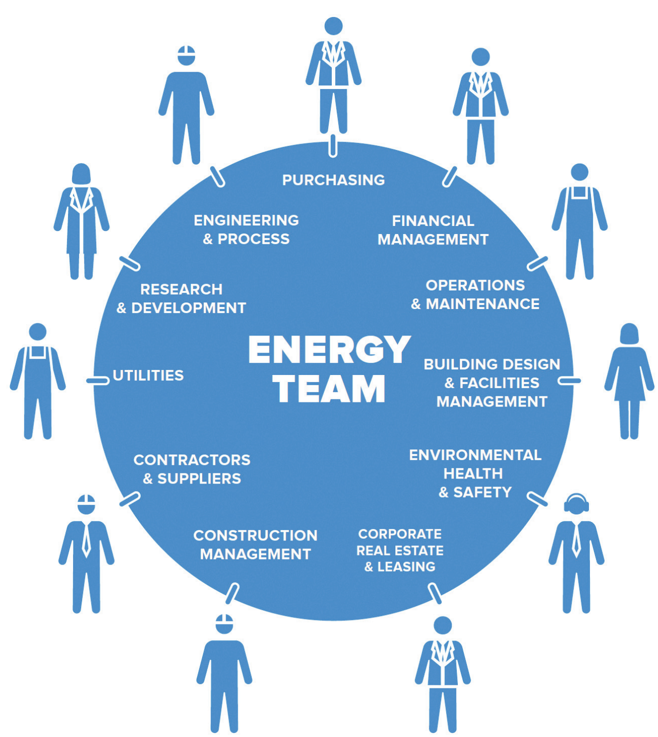

Figure 4 *A possible energy team structure for a successful and collaborative DER project (EPA n.d.).*

existing lighting fixtures to high-efficiency LEDs. By first addressing building loads like lighting, the team was able to reduce the chiller's cooling capacity by over 40%, resulting in a downsizing and capital cost reduction opportunity for the central chilled-water system and greater overall value for the project (RMI 2015a).

Retain Bundles and Allow for a 25-Year Maximum Contract Term. In communicating their desire for deep energy savings, agencies should also clearly communicate an acceptance of projects that approach the 25-year maximum contract term. Statute allows for a contract term of up to 25 years, which applies broadly to federal ESPC contracts. EISA specifically prohibits policies that limit the maximum contract term to a period below 25 years, but artificially low contract term limits (e.g., 10, 15, or 20 years) are still sometimes requested (even if not formally), which will prevent any project from achieving its full DER potential. Encouraging longer contract terms can enhance a project's value by incorporating more substantial energy improvements, such as full HVAC system replacements. This can also allow for costly building infrastructure replacements with a long payback that agencies could otherwise not afford through appropriated funding (e.g., building roof replacement).

In reviewing the PA and IGA reports, agencies should consider the payback and value of whole bundles of ECMs rather than pulling out individual measures. Separating measures from bundles can significantly hinder project economics and eliminate much of the proposed value of the project to the government. For example, expensive building-envelope measures like roof replacements could work in harmony with HVAC system replacements and other measures to drive deep HVAC load reductions which, in turn, reduce the size, capital costs, and energy consumption of the HVAC equipment installed. Considering longer-payback ECMs alone could compromise their viability as part of the project. Conversely, only considering fast-payback load reduction measures could unintentionally make the HVAC system replacement more expensive and/or financially unfeasible as a stand-alone measure in the future.

Gather Good Data; Set Expectations. Agencies should obtain and provide as much data as possible for the ESCO at the outset of the project (during the PA kickoff at the latest). Data that is correct and detailed can save time for the ESCO and agency, result in more accurate energy savings and cost estimates early in the project, and help the agency manage its assets and energy consumption in the future. At a minimum, this data should include two to three years of utility information (energy, water, sewer, and other bills, including rate structures), prior energy studies, ongoing contract costs and scopes for O&M or energy services, requirements for contractor security clearances, and information on recent, concurrent, or near-term improvements to the building or changes in occupancy that could affect the energy use of the building (Shonder 2014).

Use Appropriated Funds to Drive Greater DER Value. Although it is challenging to identify when and how much appropriated funding will become available, agencies and ESCOs should always have a plan to use appropriated funding to drive greater value in ESPC projects. Should appropriated funding become available, ESCOs and agencies can plan to incorporate long-payback measures and infrastructure improvements to increase a project's value. If time or other constraints prevent the inclusion of more measures, a secondary solution is to use appropriated funding to buy down project costs and reduce the contract term. Using appropriated funds to drive greater DER value is a critical and currently underutilized opportunity.

Construction, Occupancy, and Verification

Balance Risk with Measurement and Verification. Agencies and ESCOs should consider the risks and benefits of various measurement and verification (M&V) strategies, and these should be discussed from the time that ECMs are proposed during the PA or IGA phase. *International Performance Measurement and Verification Protocol*® (IPMVP®) M&V Option C (FEMP 2015) should be considered for projects that generate substantial and holistic savings that cut across multiple systems (e.g., HVAC and building envelope ECMs). Option C is a whole-facility-level or sub-facility-level measurement that can account for more holistic retrofits when compared with other M&V options. In order to fully balance risk, Option C can be used for one to three years, with a subsequent transition to a cheaper and lower-risk M&V option. By using Option C for these types of projects, stakeholders are able to more clearly see the direct impact on their utility bills (Avina and Shonder 2013).

Share Project Successes and Lessons Learned through Case Studies. Case studies are very helpful in an industry where precedent can justify new and forward-leaning ESPC practices that support DERs. When agencies and ESCOs take on the risk of testing a new ESPC approach or technology, they should share their successes to help the industry raise the ESPC standard and share their failures to help others learn from and ultimately overcome potential roadblocks. Several case studies are available in *Deep Energy Retrofits Using Energy Savings Performance Contracts: Success Stories* (RMI 2015a).

BEYOND BEST PRACTICES

The GSA's NDER program, the Army, FEMP, DLA Energy, and others have worked well to exemplify ESPC process best practices for driving deep energy savings. This section aims to continue this trajectory by pushing the leading edge of federal ESPCs further and enabling deeper levels of energy savings. Some of these concepts suggest specific areas for improvement within the ESPC process, but they all remain flexible to meet the legal, regulatory, and logistical hurdles that often constrain ESPC projects.

Develop a Long-Term Energy Master Plan before Soliciting Future Energy Projects

Agencies should make the most of audits, including the periodic energy audits on critical facilities that are required every four years under Section 432 of EISA, by requesting key information that enables long-term master planning of the building. With this information, the long-term master plan for the building can be assembled and periodically updated to guide energy-savings projects for years to come. Key information includes asset conditions, planned future upgrades, and control system condition and meter calibration; a full list is available in *Deep Energy Retrofit Request for Proposals (RFP) Guidance* (AIA 2016). This information can determine ideal intervention points and consider the interactive effects between projects along this road map to ensure that future intervention points are not mitigated by uncoordinated short-term projects.

Envision Net-Zero-Energy-Ready Scenarios

Agency energy goals can be reinforced and strengthened if ESCOs are asked to propose a net-zero-energy-ready scenario for a building early in the process. This can be achieved by asking ESCOs to propose such a scenario as part of the PA submission. This scenario would completely maximize building energy efficiency reductions within the 25-year contract term to a point where the remaining energy consumption could readily be offset by on-site renewables. This scenario would also include an evaluation of renewable energy site potential and a preliminary proposal for an energy services agreement (ESA) that can be included as part of the ESPC, where consistent with agency authority.

Requiring that ESCOs push the bounds of ESPC projects toward net zero energy should lead to more creative and comprehensive bundles of ECMs that might not have been uncovered in a business-as-usual ESPC development scenario. Incorporating an ESA proposal further provides the agency with an estimate of the cost of on-site renewable energy generation. Agencies should incorporate ESAs that come in at or below grid electricity prices and should consider ESAs with a slight cost premium if they help to achieve agency energy goals. Even if some aspects of the net zero energy scenario are ultimately deemed unviable by the agency, the process should improve the implementable solution that the ESCO proposes and refines during the IGA, while showing the ESCO that the agency is committed to the deep energy savings, renewable energy production, and ultimate net zero energy goals outlined in EO 13693.

Include Occupant Behavior and Operations and Maintenance Savings

Occupant behavior programs are effective, low-cost insurance policies against savings losses and can provide significant, sustained savings. Metering and submetering associated with informative plaques and real-time displays provide invaluable information to reduce energy use and inform and motivate occupants. Projects should strive to incorporate occupant behavior savings into ECM bundles wherever possible to ensure that occupant-controlled loads are adequately addressed and sustained by the ESPC.

Operation and maintenance should be included as part of an ESPC contract when the ESCO has demonstrated that the proposed project will reduce O&M costs and that they can competently deliver O&M services. Having the ESCO involved in the facility over time should maintain ESPC project energy savings, uncover new savings and ongoing improvement opportunities, and support deep-over-time energy savings. When implementing this longer-term relationship, it is crucial that the facility management team be incorporated early in the project and that a strong relationship be developed between the building and ESCO O&M staffs while implementing and managing day-to-day tuning and operational changes.

Capturing O&M savings in an ESPC is typically seen as a benefit to agencies and ESCOs, as these savings can help to pay for additional ECMs. However, modifying or replacing existing O&M contracts to align with ESPCs can conflict with internal goals, such as small business contracting requirements and any federal requirements to recompete O&M contracts during the term of an ESPC. While solutions to this issue vary, agencies should seek greater alignment between upcoming ESPCs and O&M contracts to provide ESCOs with a fair opportunity to leverage the benefits inherent in incorporating O&M in ESPCs.

Achieve Deep-Over-Time Energy Savings

Many of these crucial concepts underlying a successful building life-cycle approach to DERs or net zero energy can be delivered using a deep-over-time (DOT) process. A DOT process unlocks energy savings over time in order to maximize cost-effectiveness and overall energy savings by logically combining energy projects with other events in a building's life cycle. This process links iterative optimization and load reduction measures together to lay the foundation for completing a DER when a trigger, or a key building energy milestone such as major equipment replacement or change of space use, emerges. This long-term approach relies on having a building energy master plan, which provides a road map of ECMs and projects that align with these triggers. This master plan should be informed, procured, and managed by the building owner agency, while the detailed analysis and design could be performed by a third-party designer or planner.

The DOT process is fundamentally different than traditional energy retrofit projects like ESPCs that operate on a tight time frame, but it can work in tandem with these projects if they are appropriately planned. The traditional approach creates a step change in building loads and is typically independent of the timing of measures and interactions between projects. As Figure 5 demonstrates, the DOT approach uses an energy master plan as a framework to properly time load reduction projects that lead to larger, well-timed retrofits that encompass major equipment upgrades. The DOT process and the corresponding energy master plan can be a means to frame a series of ESPC projects or multiple intended phases of a single ESPC, leveraging the economic and logistical advantages inherent in timing these projects. An ESCO may deliver individual phases or a collection of phases or have an ongoing role in the DOT energy master plan. While the ideal scenario is to have a consistent contractor involved throughout the project, this is not always possible due to contractual limitations, timing, or other complications.

Timing is essential to a cost-effective retrofit, as not every building is ready for a deep retrofit. Often, it is not economically feasible to replace costly systems (e.g., an entire air-handling system) and building components (e.g., windows) on energy and maintenance savings alone. While the best practice of bundling ECMs (detailed previously) should be used to incorporate these large replacements in ESPC projects, these measures can become much more economically attractive when they are timed with the end of the useful life of equipment to allow the owner to capitalize on the reduced equipment sizes resulting from those ECMs (AIA 2016). Therefore, it is crucial to determine where the building is in its life cycle and what the building's long-term energy master plan should look like. Figure 6 illustrates a common path throughout a building's life cycle of achieving deep energy savings. The following paragraphs define the phases shown in Figure 6.

Phase 1, Independent ECMs. Phase 1 informs the development of an energy master plan and works to optimize existing systems. Available data are gathered through audits and available meters on site. At the same time, existing control systems are tuned and retrocommissioned to save energy and gather information on the building's operation. If sufficient submetering is not in place on site, this is a prime opportunity to install meters and better inform retrocommissioning opportunities.

Phase 2, Load Reduction ECMs. Phase 2 focuses on projects that reduce the building's heating and/or cooling loads, such as building envelope improvements, lighting efficiency upgrades, and plug-load energy reductions. The goal is to affect any systems that affect the heating or cooling loads in the building. For example, upgrading from T8 fluorescent bulbs to light-emitting diode (LED) lighting reduces heat gain and the resultant cooling loads for a given space, and sealing drafty windows reduces heating and cooling loads in a given space. The cumulative effect of these projects is the ability to downsize major HVAC equipment when it is ripe for replacement at the end of its useful life. Having an energy master plan that includes these smaller, independent load reduction projects is crucial for having shovel-ready projects. These projects are not dependent on triggers, so they can be implemented whenever funding becomes available or when an energy project is initiated, which adds confidence that the project fits within the deep retrofit progression.

Phase 3, HVAC ECMs. Phase 3 begins when major equipment nears the end of its useful life. Instead of replacing equipment "like for like," entire systems should be considered for partial or full redesign. By doing this, systems can cost less than (as a result of system downsizing and the load reduction measures in phase 2) or about the same as a like-for-like replacement, which would require similar expenses related to a system overhaul. The combination of lower loads and a new system that considers a whole-system redesign will deliver powerful savings, particularly in buildings with outdated and inefficient existing systems. Lower system sizes enabled by load reduction and improved system design capture capital and O&M cost savings from previous measures and provide a strong return on investment for the entire DOT process.

Phase 4, Maintain Performance. Phase 4 continues throughout the building's useful life to provide the greatest long-term savings. It is crucial that O&M teams and building occupants remain involved in phase transitions to ensure continued performance. This phase for a typical building considers only reacting to emerging issues, but, with a DOT

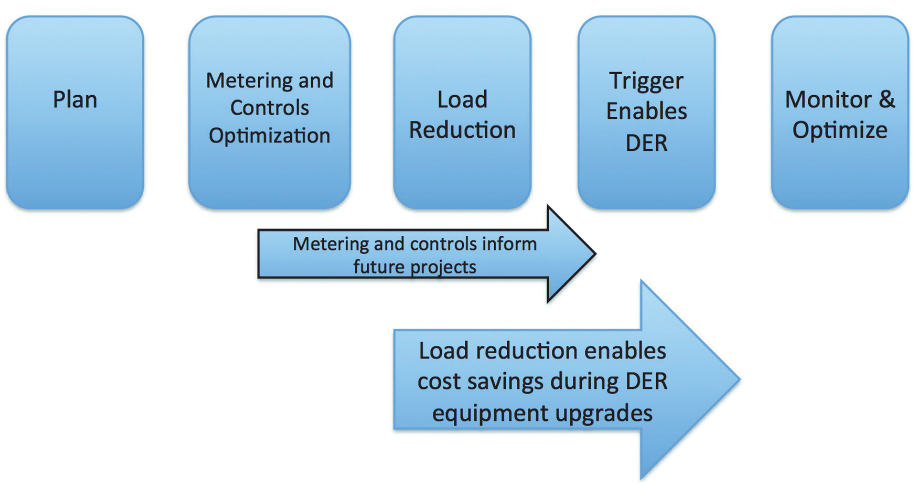

Figure 5 *The progression of a deep-over-time process.*

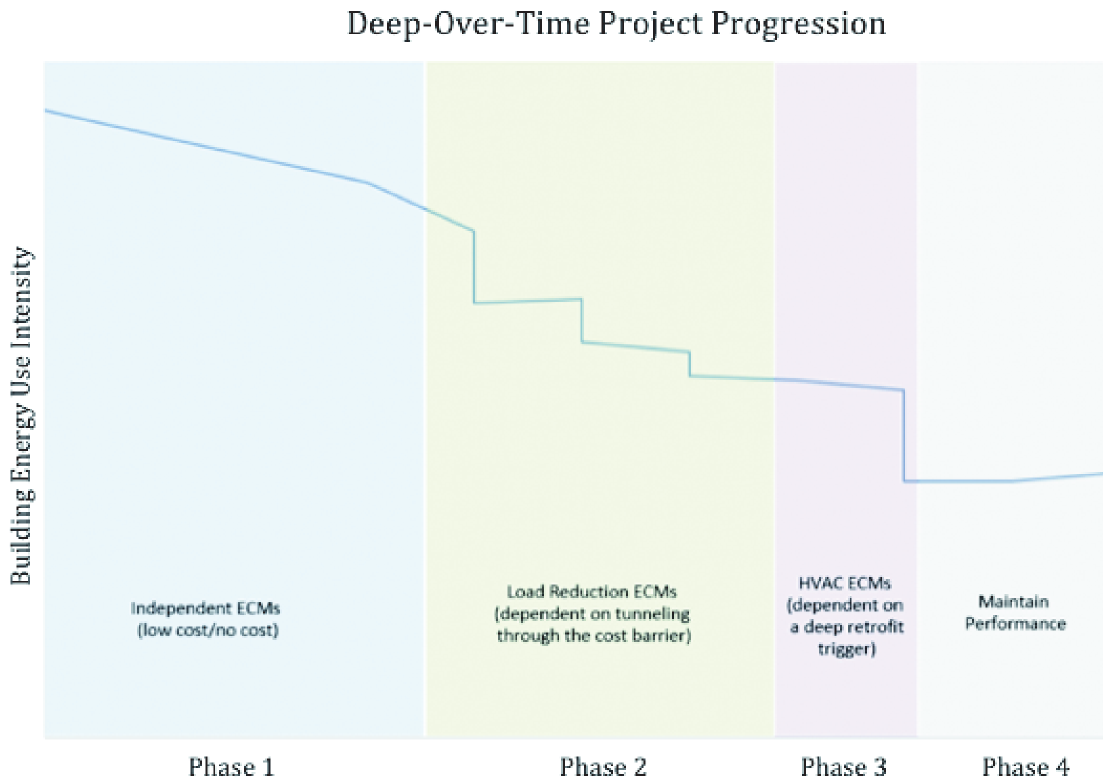

Figure 6 *Building infrastructure investment phases, demonstrating energy savings captured through a series of timed interventions (AIA 2016).*

process, it should be a much more active process to tune and refine the building's performance.

Incorporate Deep-Over-Time Concepts into Federal ESPCs

Deep-over-time retrofits can be executed through a series of well-defined ESPCs that deliver on an overarching plan, as demonstrated in Figure 7a, or through a longer ESPC relationship where a single ESCO and owner build a long-term relationship to manage a long-term series of well-timed projects (or project phases), as shown in Figure 7b. The second strategy is preferred but could present contracting complications with some agencies as it relates to competition requirements. Within either contracting strategy, delivering an economical DER relies on several basic tenets: creating an energy master plan, building capacity reductions through successive load reduction measures, and capitalizing on major equipment replacement triggers.

No matter the contractual approach, it is crucial that all team members buy into the holistic, long-term perspective this approach requires. All parties need to consider longer-term projects with longer-payback ECMs that require extended relationships between the ESCO and agency while resulting in greater value over time. The federal government would need to determine the best mechanism for properly timing these long-term engagements, whether it includes multiple ESPCs over time; a single, longer multiphase contract; or a different strategy altogether. Additionally, more resources will be required in project planning to gather additional data and engage all stakeholders. Balancing the many trade-offs between DOT and current best practices can be difficult, but it is important to keep in mind that even if the full DOT process is not applied, the concepts of first focusing on load reduction and responding to major triggers can be applied to many traditional projects.

Combine ESPC and Appropriated Funding to Drive Projects Deeper

Limited and constrained funding sources are driving federal agencies to find innovative financing and contracting models to deliver the most savings from every dollar spent. ESPCs play a crucial role in providing agencies with energy and water savings without appropriated capital funding from Congress, but these projects cannot always leverage multiple funding sources to drive greater energy savings. Agencies like the GSA and the DoD have been exploring innovative contracting and funding models that combine appropriated funding with ESPCs to drive DERs in major renovation projects. These agencies have had some success in applying appropriated funding to ESPC projects, but there must be a common understanding of legal issues before agencies can broadly

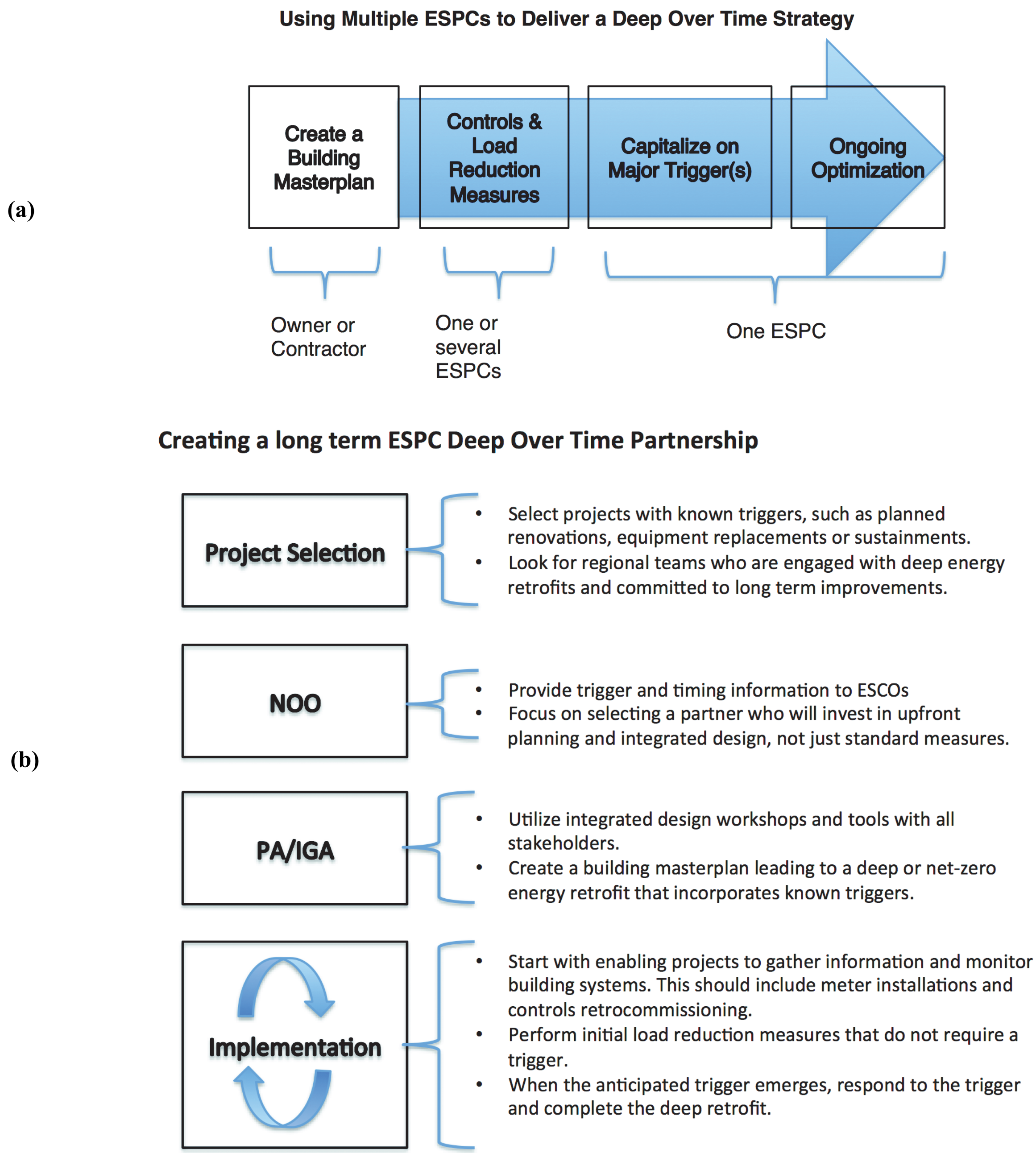

Figure 7 *Deep-over-time process that could be used (a) along with multiple ESPCs over time at a given facility or (b) with fewer ESPCs or even a one-phased ESPC for a given facility.*

implement combined funding projects that include both energy services and non-energy renovation projects.

Understanding the Opportunity. In order to maximize the value of DERs, agencies need to both understand the opportunity of pursuing a DER with combined funding sources and be prepared to act when the timing is right. Developing an energy master plan, as suggested as part of a deep-over-time process, is the key first step to understanding the opportunities that a site may offer. It is crucial to have an independent third party lay out the site's energy master plan so that the agency can have a neutral opinion that can inform requests for appropriated funding and potential ESPC projects over time. This energy master plan should be closely coordinated with an energy capital investment plan, so that an agency can be prepared to execute and fund energy-related projects appropriately as funding becomes available. Additionally, the energy master plan should remain flexible to pursue combined funding projects as energy-related funds become available.

Guidance and Legislation that Allow Combined Funding. Existing guidance and legislation allow for combining ESPCs with appropriated funding in situations where that funding has been specifically designated for related projects, where the appropriated funds are intended for energy-related projects. DOE has guidelines regarding one-time payments and one-time savings or cost avoidance in ESPCs that were accepted by the Federal ESPC Steering Committee on December 5, 2006 and updated in January 2009 (FEMP 2009). These guidelines explain how appropriated funds can be applied to an ESPC and apply to projects that are solicited and awarded as an ESPC. The law, 42 U.S.C. 8287 (GPO 2006), has a provision that allows for some appropriated funding to be applied to an ESPC. This enabling legislation provides that ESPCs are for the purpose of "achieving energy savings and benefits ancillary to that purpose (p. 6588)." It also states that payments to an ESCO "may be paid only from funds appropriated or otherwise made available to the agency for fiscal year 1986 or any fiscal year thereafter for the payment of energy, water, or wastewater treatment expenses (and related operation and maintenance expenses)" (p. 6591).

It is imperative that the appropriated funds that are going to be applied to an ESPC are directly related to the energy measures being executed by the ESCO. For example, if an agency had funding available that was intended to replace existing single-pane windows with slightly more efficient double-pane windows, an ESCO, as part of an upcoming ESPC, could finance the incremental cost of more advanced triple-pane windows that will further reduce building loads. The appropriated funding for the original window replacement could be applied to the ESPC as a one-time payment, which would drive greater value from the window replacement through added energy savings and overall project cost-effectiveness. This can result in an increased scope for the ESPC project (or an opportunity for the agency to buy down the ESPC contract term). If this project is timed with the trigger of central HVAC system replacement, the reduced heating and cooling loads from the triple-pane windows could allow a less expensive, lower-capacity HVAC system replacement. These synergistic approaches are what enable the 50% savings achieved in deep retrofits (Shonder and Nasseri 2015).

Precedent for Combined Funding Projects. There are several examples of successfully using combined funding methods as part of a new construction or major renovation project. In some key instances, projects have been able to leverage combined funding to drive new construction or major renovation projects toward their energy savings potential.

The Federal Research Center at White Oak (FRCWO) project is a prime example of this. By combining ESPC funding with a new construction project, the GSA was able to free up over $200 million of planned capital funding that could be reapplied to meet the functional requirements of the key tenant at FRCWO, the U.S. Food and Drug Administration (FDA). This required extensive collaboration between the GSA, the ESCO, the FDA, the DOE (project facilitator), and the architecture and engineering firm to increase project scope without increasing costs to the government or the taxpayer. The FRCWO project, once complete, will be a state-of-the-art, 3.9 million square foot, $1.5 billion office and laboratory compound for the FDA (Smith 2011). The biggest lesson learned from this project thus far was that if the appropriated funding had been identified earlier in the design process, the designs could have incorporated greater energy savings and the construction process could have been better coordinated between all of the key stakeholders. Early information and planning is critical and necessary to fully leverage combined funding.

A similar trajectory is being planned for the Intelligence Community Campus (ICC) in Bethesda, Maryland. The ICC is a major campus redevelopment project that is also targeting improvements in campus energy efficiency and energy security. With a shortfall in appropriated funding, the project team decided to combine UESC funding with appropriations, which are expected to keep the project on schedule (due to earlier availability of third-party funds) and within its construction budget while delivering on its energy goals. The multiphase ICC project is ongoing and is expected to successfully implement combined funding methods to achieve its energy goals (Wheeler et al. 2015).

Timing is Key. The alignment of the work being performed by the ESCO with the arrival of appropriated funding that could be applied to the ESPC is critical. One key challenge faced by the Army is that, for any given installation, it is not always certain which appropriations will be approved until Congress takes action to approve budgets, which can take place three to six months into a fiscal year. If an ESCO performing work at a given installation is made aware of the energy-related items included in the budget, the ESCO could more deliberately evaluate additional ECMs that could be implemented if the budget is approved and the installation receives the funding. However, there is added development risk for the ESCO and schedule risk for both parties if the ESPC needs to move forward before the funding is received. If the funding does not come through, the applicable ECMs would need to be removed from the project if they cannot be paid for as part of the stand-alone ESPC.

Challenges in Combining Energy and Non-Energy Projects. While a combined funding approach can deliver deeper savings on limited budgets, there are several barriers preventing broad implementation. In federal contracts, ESPCs can only be paid from the savings that are generated from work that is executed as part of the ESPC. When an installation receives appropriated funding for an SRM project, that project is supposed to be solicited based on the rules in the *Federal Acquisition Regulations* (FAR) (GSA 2005). This process can, but does not currently, consider the potential to combine an ESPC effort with the SRM funding that could be used for related (energy-related) projects. If there were no relationship between the ESPC projects and the funded project, the FAR would prevail and the non-energy related scope would need to be solicited separately from the ESPC efforts.

Soliciting the non-energy related scope separately from the ESPC efforts complicates the project's efforts. From a logistical standpoint, having two or more contractors on site that are implementing closely intertwined scopes adds complexity to project implementation. Client teams would need to coordinate two contractors with different contracts, schedules, subcontractors, and scopes to work together in the same space at the same time, without adversely impacting the project as a whole.

The major legal limitation is not necessarily identifying what scope can be performed by the ESCO under an ESPC. The legal limitation relates to whether or not an agency can advertise a funded project as an ESPC because, by law, ESPCs are third-party-financed arrangements. Generally, an ESCO may only perform energy- or water-related conservation measures and related ancillary construction (such as concrete pads under and enclosures around equipment) and O&M work. If a funded project is solicited to an ESCO group, it is likely that the contract community that normally bids those types of projects would protest that the work is not ESPC work. However, current rules allow an ESCO that is performing related work to use funding as a one-time payment (for agency cost avoidance) if the funding becomes available to use during the right stage of ESPC development. However, the challenge of timing remains significant. Early communication and awareness at an agency or installation regarding projects that could build upon each other to achieve savings is key, but there is always an underlying risk that planned funding will not be made available.

Potential Contractor Arrangements. As described previously, there are challenges associated with having separate contractors working on the respective energy and non-energy project scopes. Collaboration between several contractors on one larger project could take many forms. In one instance, an ESCO could serve as a subcontractor to a prime contractor, like a general contractor, delivering non-energy services as part of the SRM project. In this scenario, the agency would not have any privity with the subcontractor, so they would have to work through the prime contractor. Also, the agency's relationship with the prime contractor would likely be awarded as a construction contract, an O&M contract, or a service contract, which could include some construction effort. Those types of contracts would be subject to the FAR and can generally be in place for only five years. This would prevent the agency and the ESCO from benefiting from a longer-term partnership of up to a 25-year contract term, which is necessary to deliver substantial energy savings as part of a DER. There are no regulations in place that can bridge the gap of the agency's ability to work with the subcontractor.

There are also challenges if the ESCO is the prime contractor and the agency is trying to incorporate the SRM project or project funding with the ESCO work. There has been ongoing discussion to evaluate methods that could be used where an ESCO is in place and has the potential to add value to SRM work. One potential option is for the ESCO to provide equipment to a prime contractor as government furnished equipment. There are several challenges with how this could transpire, since the SRM contract assumes that the funding covers the entire project (including energy and non-energy scopes). The ESCO and an SRM contractor would have to work out the specific arrangements that would allow for this to happen—ensuring that neither contractor performs work outside the scope of their respective contracts. There could also be challenges during the operation phase of the ESPC if the ESCO alleges that the provided equipment was damaged or not properly installed by the SRM contractor and that this is the reason that savings are not being realized. So, there are many challenges when separate contractors are hired to perform related energy and non-energy work on an SRM or similar project.

In summary, there are legal issues with how a contract can be structured to comply with 42 U.S.C. 8287 and not violate the FAR if appropriated funds are anticipated to be available at the time of contract award. There are privity-of-contract issues if the ESCO is a subcontractor to a prime on an SRM project, which inhibits the agency's ability to accept a comprehensive ESPC project from the prime. There are also issues with an ESCO performing work that is not energy work. Some limited non-energy work could be allowed, but substantial non-energy-related work performed by the ESCO or a subcontractor to the ESCO would not be allowed. So, it is critical that, if there is a potential project that could achieve greater savings using the DER concept, the team evaluating that project knows and understands the procurement rules, clearly delineates the energy and non-energy scopes, and works closely with their legal team to bring the greatest value to the ESPC project.

CONCLUSION

Deep energy retrofits have the power to deliver on federal energy mandates and transform the federal energy sector working with the resources available to the government today. ESPCs can more than double average energy savings by deliberately and consistently employing the best practices exemplified by GSA NDER, the Army, FEMP, and others. Agencies should continue building on best practices to push the sector to new levels of energy performance.

A deep-over-time approach should be adopted by federal agencies to ensure that all energy renovation projects in a given facility are executed under a cohesive, long-term energy master plan that delivers greater collective impact than isolated energy conservation measures. By developing an energy master plan that optimizes existing systems, reduces loads, replaces major systems, and maintains performance (in that order), agencies can gain more long-term value from each investment in their buildings.

Maximizing existing funding streams is also critical to driving more value from the taxpayer dollar. ESPCs and appropriated funding can each deliver DER projects independently but, if combined, they can increase the rate and depth of DER projects. Combining funding streams is not without its challenges, and the framework put forth by this

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paper lays out the legal limitations of combined funding structures as they exist today.

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