

Updated Estimates of the Remaining Market Potential of the U.S. ESCO Industry

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LBNL and the U.S. ESCO Industry

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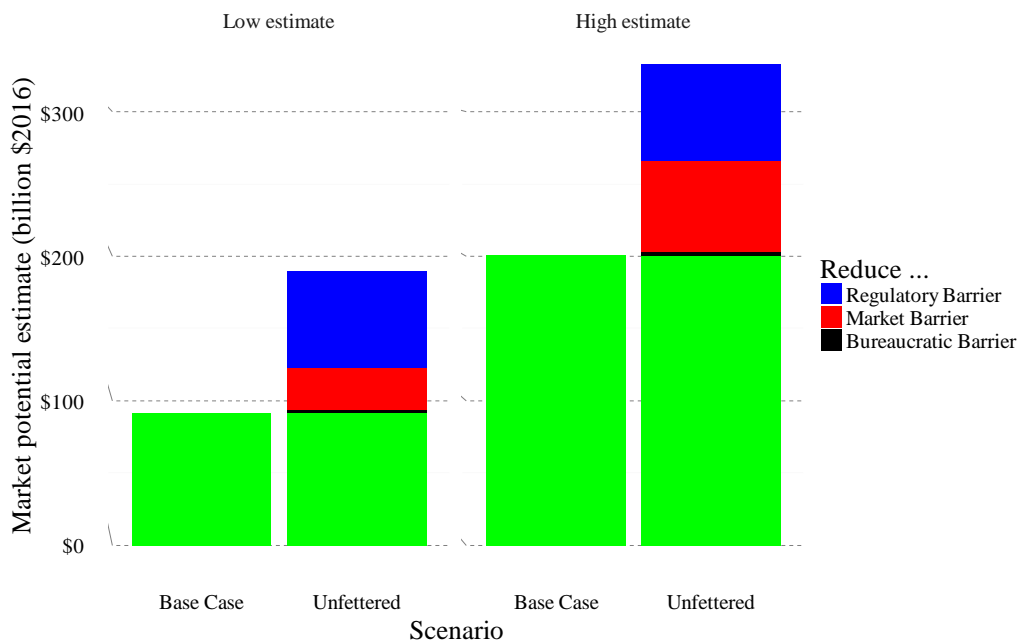
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Executive Summary

The energy service company (ESCO) industry has a well-established track record of delivering energy and economic savings in the public and institutional buildings sector, primarily through the use of performance-based contracts. The ESCO industry often provides (or helps arrange) private sector financing to complete public infrastructure projects with little or no up-front cost to taxpayers. In 2014, total U.S. ESCO industry revenue was estimated at \$5.3 billion. ESCOs expect total industry revenue to grow to \$7.6 billion in 2017—a 13% annual growth rate from 2015-2017. Researchers at Lawrence Berkeley National Laboratory (LBNL) were asked by the U.S. Department of Energy Federal Energy Management Program (FEMP) to update and expand our estimates of the remaining market potential of the U.S. ESCO industry. We define remaining market potential as the aggregate amount of project investment by ESCOs that is technically possible based on the types of projects that ESCOs have historically implemented in the institutional, commercial, and industrial sectors using ESCO estimates of current market penetration in those sectors.

In this analysis, we report U.S. ESCO industry remaining market potential under two scenarios: (1) a base case and (2) a case “unfettered” by market, bureaucratic, and regulatory barriers. We find that there is significant remaining market potential for the U.S. ESCO industry under both the base and unfettered cases. For the base case, we estimate a remaining market potential of \$92-\$201 billion (\$2016). We estimate a remaining market potential of \$190-\$333 billion for the unfettered case. It is important to note, however, that there is considerable uncertainty surrounding the estimates for both the base and unfettered cases.

1. Introduction

The energy service company (ESCO) industry has a well-established track record of delivering energy and economic savings in the public and institutional buildings sector, typically through the use of performance-based contracts (Goldman et al. 2002; Larsen et al. 2012; Shonder 2013; Stuart et al. 2014; Carvallo et al. 2016). This industry often provides (or helps arrange) private sector financing to complete public infrastructure projects with little or no up-front cost to taxpayers. In 2014, total U.S. ESCO industry revenue was estimated at \$5.3 billion. ESCOs expect total industry revenue to grow to \$7.6 billion in 2017—a 13% annual growth rate from 2015-2017 (Stuart et al. 2016). Researchers at Lawrence Berkeley National Laboratory (LBNL) were asked by the U.S. Department of Energy (DOE) Federal Energy Management Program (FEMP) to update and expand our estimates of the remaining market potential of the U.S. Energy ESCO industry. We define remaining market potential as the aggregate amount of project investment by ESCOs that is technically possible based on the types of projects that ESCOs have historically implemented in the institutional, commercial, and industrial sectors using ESCO estimates of current market penetration in those sectors (Stuart et al. 2014).

It is well-documented that there are multiple barriers inhibiting the growth potential of this industry. Examples of barriers include: (1) the reluctance of contracting officers to leverage the use of Congressionally-appropriated funds to develop larger, more comprehensive energy savings performance contract (ESPC) projects; (2) inconsistent (or non-existent) rules relating to the use of non-energy benefits in project cost-benefit calculations; (3) a historical lack of ESCO interest in retrofitting facilities with smaller floor areas; and (4) state legislation that limits contract terms. For these reasons, we report U.S. ESCO industry remaining market potential under two different scenarios: (1) a base case—an update of Stuart et al. (2014) and (2) a case “unfettered”¹ by the aforementioned market, bureaucratic, and regulatory barriers.

2. Method and Data Sources

This section describes the method used to estimate ESCO industry remaining market potential as well as key data sources. We detail how the base case remaining market potential was estimated, including key data sources used. We conclude with a discussion of the method used to re-estimate the remaining market potential after the reduction of market, regulatory, and bureaucratic barriers (i.e., the “unfettered case”).

¹ Unfettered suggests conditions that will release ESCOs to do what they always would have done. In this analysis, we simply report a maximum market potential under different scenarios. However, we do not attempt to quantify the capacity of ESCOs to actually achieve this maximum market potential. For lack of a better word, we use unfettered in this analysis to describe the maximum market potential under different scenarios.

a. Base case

The base case remaining market potential estimate is essentially an update of the approach used in the Stuart et al. (2014) report using more recent data. Stuart et al. (2014) contains more detailed information on this method, which is foundational to the analysis that follows. Estimating the base case remaining market potential involves four important steps (see Figure 1):

Step #1: Determine aggregate floor space addressable by ESCOs

The first step involves determining the existing floor space in buildings that could be subject to retrofits by ESCOs using data from several sources: (1) the 2012 Commercial Building Energy Consumption Survey (EIA 2017a); (2) the 2010 Manufacturing Energy Consumption Survey (EIA 2017b); (3) the 2015 Federal Real Property Report (GSA 2017); and (4) for public housing information—the Residential Consumption Survey (EIA 2017c), U.S. Department of Housing and Urban Development (HUD 2017a, HUD 2017b), and the Center on Budget and Policy Priorities (CBPP 2017). In this analysis, we exclude the following categories of buildings—and their corresponding floor area from our base case estimate:

- Facilities that report no energy use;
- Industrial facilities;
- Privately-owned, commercially-leased buildings; and
- Smaller facilities that ESCOs would not typically retrofit (less than 50,000 ft²).

Step #2: Determine proportion of floor space remaining to be retrofitted

Next, we draw upon unpublished market penetration estimates provided by ESCO executives via interviews with LBNL researchers in 2015. In these interviews, executives indicated the percentage share of floor space that they believed to be already retrofitted within each market sector they serve. We use ESCOs' median percentage share of market penetration and multiply that by the total floor space to estimate the aggregate floor space that has already been retrofitted at least once. We then subtract this value from the total floor space determined in the first step to estimate the remaining floor space available to be retrofitted. Through this process, we estimate that ~26.3 billion ft² of floor space is available to be retrofitted in facilities across the country.

Step #3: Determine range of project installation costs of retrofitting a square foot of floor space

We then use the LBNL/NAESCO database of ESCO projects to estimate a range of project installation costs² per square foot across all market sectors including federal government, K-12 schools, state/local government, universities/colleges, healthcare, private commercial and industrial (e.g., see Larsen et al. 2012). This database currently contains over 5,500 projects representing about \$14 billion in total project investments. We restrict our analysis to projects that were completed after 2000 and use the 33rd percentile value in each market sector as the lower bound cost per square foot and the 66th percentile value as the upper bound cost per square foot.

Step #4: Estimate base case remaining market potential

Finally, we estimate the base case remaining market potential by multiplying the remaining floor space determined in step #2 by the low/high installation cost per square foot at a typical ESCO project determined in step #3.

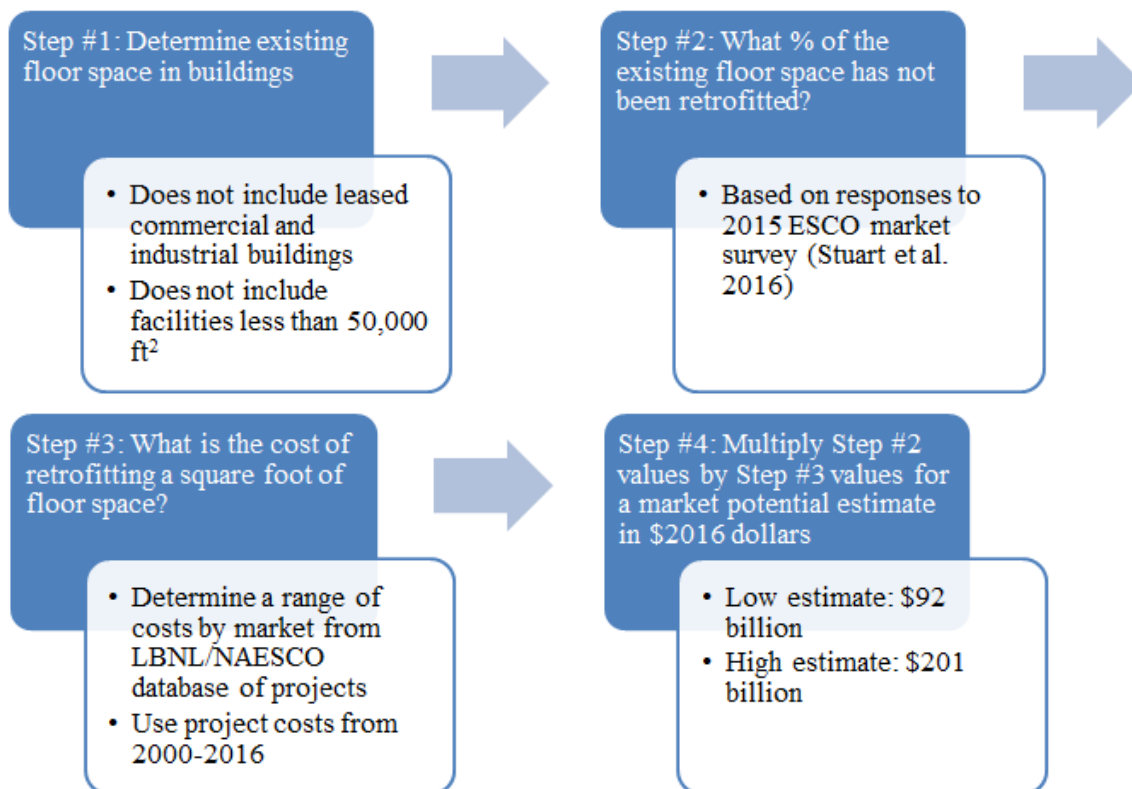


Figure 1. Steps to determine the remaining ESCO market potential: Base case

² Throughout this analysis, we use the terms project installation costs and project investment levels interchangeably.

b. Unfettered case

In general, re-estimating the market potential under the unfettered case involves starting with the base case and then changing assumptions related to (1) typical project installation costs and (2) floor area available for retrofit. Changing these two key assumptions serves as a simple proxy for reducing the market, regulatory, and bureaucratic constraints or “barriers”. Below, we discuss the motivation behind changing these assumptions and the corresponding effect on the results from removing these barriers. Table 1 is a high-level summary of the barrier, the impact to the ESCO industry, and the original (base case) and revised (unfettered) assumptions.

Market barrier #1: ESCOs have historically established requirements for minimum project investment level (because of transaction costs) which often translates into a preference for doing retrofits in larger facilities or sites.

Larsen et al. (2012), Stuart et al. (2014), and others have noted that ESCOs have historically preferred working on projects with relatively larger floor areas (i.e., greater than 50,000 ft²). However, there is evidence that new types of financing programs may make smaller-sized projects more attractive to ESCOs. For example, Commercial Property Assessed Clean Energy (C-PACE) legislation has been enacted in 33 states with 19 of those 33 states having active C-PACE programs (Pacensation 2017a). The volume of new C-PACE financing has grown by a factor of ten over just the past four years—from \$25 million in 2012 to \$350 million in 2016 (Pacensation 2017a). A number of large ESCOs have registered as providers with C-PACE programs and they are leveraging C-PACE resources to undertake smaller projects (Ameresco 2015; Johnson Controls 2013; NORESCO 2016; Connecticut Green Bank 2017). We assume that commercial PACE may increase energy retrofit and renovation opportunities in the commercial sector that ESCOs can leverage. For these reasons, we envision a future where a larger potential market exists in the commercial sector that could be more receptive to ESCO service offerings.

Accordingly, we relax the base case criteria used to filter buildings based on their size by assuming that ESCOs are more interested in providing energy services to customers with smaller facilities. The base case addressable floor area assumption is changed by using the 25th percentile of all project floor areas (by market segment) as reported in the LBNL/NAESCO database of projects. This change effectively relaxes the floor area exclusion criteria from all facilities less than 50,000 ft² to excluding facilities less than 15,000 to 40,000 ft²—depending on each market segment. In this case, our assumption of addressable floor area increases from 26.3 billion ft² to 29.2 billion ft².

Market barrier #2: ESCOs have had limited success undertaking projects in the private commercial (leased) and industrial markets.

ESCOs have historically faced difficulties developing ESPC projects in the private commercial market, especially in leased buildings where those responsible for paying energy bills (typically the tenants) are different from those who make decisions about capital improvement

investments including building owners or managers (e.g., Larsen et al. 2012; Stuart et al. 2014). ESCOs have also had limited success completing comprehensive, longer payback projects in industrial facilities. There are a number of reasons why traditional ESCOs have not been successful in marketing their services to industrial customers including, but not limited to: historically low energy prices at these facilities, industrial customers tend to require short payback times on their investments, lack of expertise in industries with specialized processes (e.g., chemical, steel), and, perhaps most importantly, the “unwillingness of industry to allow ‘outsiders’ to make process modifications” (Elliott 2002).

However, increasing uptake of PACE financing, including in leased properties, shows that PACE can help address the landlord-tenant split incentive issue noted above (Pacenaion 2017b) and thus increase the market potential for ESCOs. There is also significant evidence that the commercial and industrial markets value energy-efficient facilities, and energy efficiency is increasingly becoming viewed as “business-as-usual.” Studies of voluntary energy efficiency and green certification initiatives (e.g., ENERGY STAR, LEED) find that facilities with these certifications garner higher net operating incomes, market values, and total returns when compared to conventional properties (Pivo 2010; Eichholtz et al. 2010, 2013; Fuerst and McAllister 2011). Increasing numbers of cities are disclosing private facility energy usage information (IMT 2017) and the CoStar Group, which provides a national database of commercial and multifamily properties, announced a commitment to increase the visibility of efficient buildings in its databases (CoStar Group 2016). In 2016, the Building Owners and Managers Association (BOMA) extensively updated its Energy Performance Contracting Model (EPCM). The EPCM provides a framework as well as template documents to help commercial business owners and operators develop ESPC projects. It is designed to work with all funding sources, including C-PACE (National Real Estate Investor 2015; BOMA 2015). It is anticipated that the combination of these activities will create a more favorable business environment for ESCOs interested in accessing (1) the private commercial market and (2) facilities within the industrial sector that do not involve ESCOs making “process modifications” (i.e., industrial facilities not directly associated with manufacturing).

For these reasons, we change the base case criteria by assuming that ESCOs will be able to develop a significant number of projects in commercial (leased) buildings and a subset of industrial facilities not directly involved in manufacturing. We include commercial (leased) and industrial floor space using data from the most recent Commercial Buildings Energy Consumption Survey (CBECS) and Manufacturing Energy Consumption Survey (MECS) data (EIA 2017a, EIA 2017b), which were not included in the base case. We include all reported floor area from commercial (leased) buildings above the 25th percentile size threshold. We also assume that ESCOs could address about 20% of the total industrial floor space, which includes office space and warehouses. This change increases total addressable floor area from 29.2 billion ft² to 41.3 billion ft².

Bureaucratic barrier: Federal contracting officers are apprehensive about leveraging Congressionally-appropriated dollars to complete larger ESPC projects.

Research indicates that federal agencies often use Congressionally-appropriated funds to procure short-payback energy efficiency improvements, and rely on ESPC separately to fund longer-payback measures (Shonder 2012). However, this approach leads to significant under-investment in projects. Projects that include only higher-cost, comprehensive measures (e.g., onsite generation, major HVAC retrofits) may not be able to accommodate all available cost-effective opportunities within the federal 25-year contract term limit. Bundling shorter- and longer-payback measures into a single project enables projects to include a more comprehensive set of measures that still meet contract and cost-effectiveness constraints (Shonder 2012). Federal agencies can more effectively leverage appropriations to increase the comprehensiveness of projects by leveraging them in an ESPC project, either as a buy-down, or to cover the costs of the more expensive measures that would otherwise have a payback time longer than the maximum allowed contract term.

We change the base case criteria by assuming available floor area will be retrofitted with a more comprehensive set of measures than in the base case in order to accommodate the potential for federal agencies to leverage appropriated dollars within a comprehensive ESPC project. We apply increased investment levels per square foot, based on data in the LBNL/NAESCO database. The result increases the estimated project cost for a federal government project by ~\$1.60 per square foot.

Regulatory barrier #1: Non-energy benefits are not typically standardized, monetized, and included in ESPC project economics.

ESPC projects provide quantifiable cost savings beyond what is typically monetized within contractual constraints, including non-energy-related cost savings (Larsen et al. 2012; Larsen et al. 2014). ESPC statutes vary widely across states and many do not allow inclusion of non-energy-related savings in the evaluation of project economics. In cases where ESPC regulations disallow or discourage inclusion of non-energy benefits, including operations and maintenance (O&M) savings, project contracts fall short of capturing all quantifiable economic benefits (Shonder 2013; Larsen et al. 2014). However, it is relatively easy to quantify and monetize O&M savings. These types of non-energy benefits can greatly enhance the economics of an ESCO project.

Accordingly, we change the base case assumptions and assume that all available floor space could achieve quantifiable O&M savings in the unfettered case. This increased benefit allows for greater investment levels per square foot while still meeting contract and project economics criteria. We quantify O&M savings achieved by projects in the LBNL/NAESCO database. For these projects, we then calculate the share of project savings attributable to O&M. Finally, we apply that share of savings as an adder to all projects that could be completed in the remaining market. The cost differential varies by market segment category, but on average the estimated investment level increases by ~\$1.10 per square foot.

Regulatory barrier #2: The contract term for ESPC projects is constrained by state legislative and regulatory requirements.

Statutes in the federal/state/local government, university, K-12 schools, and healthcare/hospital (MUSH) markets constrain the maximum contract length of ESPC projects. The federal sector allows contracts up to 25 years (DOE 2012). In the state and local government sector, maximum contract term varies with most states limiting ESPC contracts to 10-20 years. Longer contract lengths allow the inclusion of measures with longer payback times that would otherwise not achieve a positive return within the allowed contract term. We model the effect of extending the contract lifetime of projects by calculating how much additional savings would be part of the contract if longer time frames were allowed. These additional savings are interpreted as additional project investment levels (higher installation costs per square foot).

Therefore, we change the base case criteria to allow for longer contract terms. We apply the average contract length of the 25th percentile of projects with the longest contract lengths, by market sector, as reported in the LBNL/NAESCO database. We estimate the net present value (NPV) of total project savings for each ESPC project in the database using its original contract length and a 5% discount rate. We then re-estimate this value assuming a longer contract length. The difference between the original and new savings NPV is the monetary effect of removing this barrier. The resulting cost differential by market category varies, but under this case, the average project installation cost increases by ~\$0.60 per square foot.

Table 1. Barriers, impacts on ESCO industry, and assumptions

Barrier Category	Specific Barrier	Impact to Industry	Original Assumption (Base case)	Revised Assumption (Unfettered case)
Market	ESCOs have historically preferred working on projects with larger floor areas (i.e., greater than 50,000 ft ²)	Projects with smaller floor areas have not been historically retrofitted by ESCOs	Facilities less than 50,000 ft ² excluded	Use 25 th percentile of all reported floor areas by market; Effectively reduces exclusion criteria to facilities less than 15,000-40,000 ft ² —depending on market segment
Market	ESCOs have had limited success undertaking projects in the private commercial (leased) and industrial markets	A significant amount of floor area in the private commercial (leased) and industrial markets has not been historically retrofitted by ESCOs	Industrial and private commercial (leased) facilities not included in aggregate floor area calculation	Include private commercial subject to 25 th percentile filter noted above; Include 20% of industrial floor space, which is an estimate of the floor space that corresponds to office space, warehouses and other similar buildings typically retrofitted by ESCOs.
Bureaucratic	Federal contracting officers are apprehensive about leveraging appropriations to complete larger ESPC projects with a more comprehensive set of energy conservation measures	Project investment levels are lower without the leveraging of appropriations	Low estimate based on median project installation cost per square foot by market segment; High estimate based on average project installation cost per square foot by market segment	Adder to base case low and high cost per square foot by applying difference in typical project costs per square foot between non-comprehensive and comprehensive federal government projects
Regulatory	Non-energy benefits (NEBs) are not standardized, monetized, and included in cost-effectiveness tests	Project investment levels are lower without consistent inclusion of NEBs in cost-effectiveness screens	Low estimate based on median project installation cost square foot by market segment; High estimate based on average project installation cost per square foot by market segment	Adder to base case low and high cost per square foot by applying difference in project savings levels for projects with O&M savings and for projects without O&M savings; Assumes O&M savings correspond directly to higher project costs
Regulatory	Contract length for projects in the federal and MUSH markets are constrained by regulatory	Project investment levels are lower with restrictions on contract length	Low estimate based on median project installation cost per square foot by market segment; High	Calculate 25 th percentile of longest contract terms by market; Adder to base case low and high cost per square foot by applying difference in net present

Barrier Category	Specific Barrier	Impact to Industry	Original Assumption (Base case)	Revised Assumption (Unfettered case)
	requirements		estimate based on average project installation cost per square foot by market segment	value of savings from base case contract length and 25 th percentile of the longest contract lengths; Assumes additional savings correspond to higher project costs

3. Selected Factors that Influence Estimates of U.S. ESCO Market Potential

It is important to note that there is considerable uncertainty surrounding the estimates for both the base and unfettered cases. Figure 2 provides a summary of some factors that may contribute to a higher or lower realized market potential than is captured in our preliminary estimate. The sub-sections below provide details about each factor.

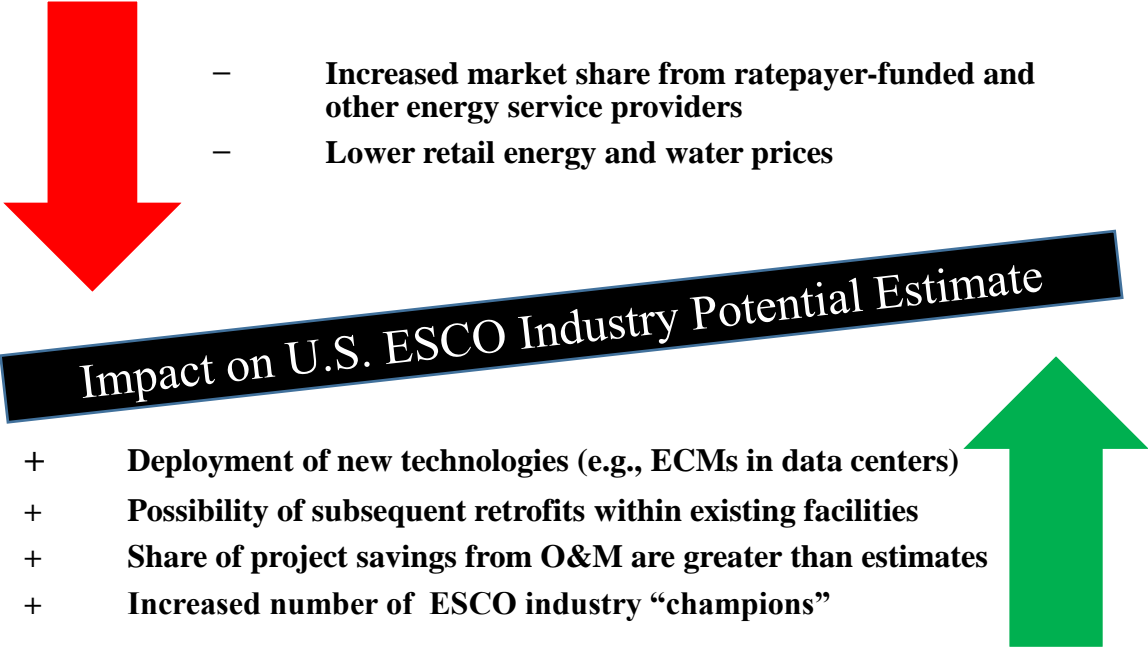


Figure 2: Factors that may contribute to a higher or lower market potential than estimate

a. Selected factors that could contribute to the market potential being *higher* than our estimate

Our definition of market potential excludes a number of factors that might contribute to a market potential greater than our current estimate including: (1) the impact of new technologies as they become available; (2) a subsequent round of projects in buildings whose retrofits are now beyond their expected useful life; (3) underestimation of actual O&M savings possible in projects; and (4) an increase in local/state/federal stakeholders that “champion” energy efficiency and the use of ESPC.

Deployment of new technologies

The deployment of new technologies could have a significant impact on the market potential for the U.S. ESCO industry. For example, data centers, which consume ~2% of U.S. electricity can expend half of their power/energy on HVAC systems, lighting, and uninterrupted power supplies (Shehabi et al. 2016). Existing retrofits to data centers most frequently involves replacing information technology equipment with less activity directed towards upgrading HVAC systems and other energy conservation measures (Shehabi et al. 2016). There are a number of large, vertically-integrated ESCOs that both develop and deploy emerging technologies which can increase the market potential beyond what was originally estimated based on efficiency technologies that were commercially available during the last 5-10 years.

Possibility of subsequent retrofits in existing facilities

Building owners and operators may opt for additional retrofits in a facility that has implemented an ESCO project if they have not captured all technical opportunities. This may result in higher investment levels per square foot than captured in our estimate. ESCOs report that repeat customers account for 15-50% of revenues in the MUSH market and more than 60% of ESCO revenues in the commercial and industrial sector (Stuart et al. 2016). Projects done for repeat customers may increase the available floor space that can be retrofitted.³ It should be noted, however, that it may be a decade or more before an additional retrofit is warranted.

Possibility that share of project savings due to O&M savings could be higher than historic levels reported by ESCOs

It has been reported that public facilities, which are often targeted by ESCOs, have a significant backlog of deferred maintenance. U.S. K-12 schools, for example, have a total maintenance backlog of at least \$250 billion (Larsen et al. 2012; Crampton and Thomson 2008). However, O&M savings potential may have been under-estimated in this analysis, because projects in the LBNL/NAESCO database inherently reflect the historical limitations on measurement, verification, and incorporation into contracts of this type of non-energy benefit. Projects in the LBNL/NAESCO database that report O&M savings indicate—on average—that ~20% of their monetary savings came from O&M. For projects in the 75th percentile of O&M savings, the share of O&M savings to total savings increases to ~40%. Unfortunately, we found no other information in the literature to confirm the share of O&M savings to total savings specifically at projects undertaken by ESCOs. Accordingly, we compile information on reported O&M expenditures for different types of buildings and compare against the “unfettered” estimates. For the assumptions described above, the “unfettered” estimate is equivalent to \$0.11 sqf-yr of O&M savings. We find a wide disparity of reported expenditure values and an unclear

³ This occurs because some floor space that was previously retrofitted by ESCOs could receive additional high efficiency measures or equipment.

definition of what is actually included in other assessments of “O&M”. Other studies report O&M expenditure values ranging from \$0.19 sqf-yr to \$2.35 sqf-yr (Gordon and Haas 1996; IREM 2012). For this reason, we believe there may be room for higher O&M savings share at projects—and thus higher market potential (and investment level)—than our initial estimate based on historical information in the LBNL/NAESCO database.

Increased presence of local/state/federal agency “champions”

Increased presence and influence of ESPC champions could result in greater investment levels than captured in our base case estimate of market potential. All 50 states have enacted legislation that enables various types of institutional facilities in a state (e.g. state/local government, state university/colleges, K-12 schools) to engage in ESPC (Durkay 2013). Reports on barriers and best practices in federal and state ESPC programs highlighted findings that champions at the executive level and throughout organizations are vital for establishing and maintaining active, successful ESPC programs over the long-term (GSA 2015; Walther and Arwood 2016). In some states, governors have enacted executive orders and established programs—with support of champions in state energy offices—that have led to significant increases in ESPC investment levels. However, states vary widely in terms of level of ESPC activity and cumulative investment to date per capita (ESC 2017). Further, ESPC activity levels can increase dramatically when champions are present. Examples include:

- The State of Nevada Governor’s Office of Energy (GOE) established its Performance Contract Assistance Program (PCAAP) in 2014. The PCAAP provides financial incentives for investment-grade energy audits and technical support to public agency ESPC projects in exchange for abiding by the program’s policies and procedures. Since inception, GOE has awarded \$1.1 million to accelerate ESPC in the state, and currently anticipates processing \$210,000 in incentives that will lead to \$12 million in performance contracts in 2017 (Nevada Governor’s Office of Energy 2017).
- Kansas was an earlier adopter of ESPC enabling legislation with the initial program beginning in 2000. This program quickly expanded from retrofitting only state-owned facilities to completing ESPCs in county, municipal and school district facilities. The state energy office director at the time instituted several best practices to streamline the ESPC process including: establishing a set of pre-qualified ESCOs, enlisting state attorneys into the contracting process, and developing a self-funding program by charging a fee to universities, school districts, and others in exchange for technical assistance from the state. As a result of this “champion”, Kansas has continued to be a leader in terms of per-capita investment levels. In 2012, the Energy Services Coalition ranked Kansas second in the nation in dollars per capita invested in ESPC (~\$91); third in total investment in performance contracting, at ~\$259 million; and third in job-years created totaling ~3,000 (Wiegman 2012).
- In 2004, Pennsylvania Governor Rendell signed Executive Order 2004-12 which enacted a number of energy efficiency requirements for state buildings (Commonwealth of Pennsylvania 2004). The order made the state’s Department of General Services (DGS) responsible for meeting the targets and developing procedures for state ESPC projects (Bharkvirkar et al. 2008). DGS set up a special office, which championed the governor’s goals and implemented about \$600 million in ESPC projects during that period.
- Retired Vice Admiral Dennis McGinn served as Assistant Secretary of the Navy for Energy, Installations, and Environment from 2013 into early 2017. During McGinn’s three year tenure, the Navy implemented over \$260 million in ESPC projects under DOE’s Federal Energy Management Program IDIQ program, representing over \$650 million in cumulative guaranteed savings.
- Katherine Hammack was Assistant Secretary of the Army for Installations, Energy, and Environment from 2010 into early 2017. Assistant Secretary Hammack focused on streamlining ESPC-related processes. The effort of Assistant Secretary Hammack and her team resulted in \$1.2 billion in ESPCs awarded over five years—an investment level that was equal to the cumulative investment over the previous 18 years (Vergun 2017).

- b. Selected factors that could contribute to the market potential being *lower* than our estimate

Our methods also do not account for two factors that could reduce the ESCO market potential including: (1) energy efficient investments occurring independent of ESCOs through utility-administered efficiency programs or other types of energy service providers; and (2) the expectation of low electricity, energy, and/or water prices over the long-run.

Ratepayer-funded Demand-Side Management (DSM) programs may serve some of the market

Efficiency investments occur in a dynamic market with multiple players and changing conditions. A market potential for ESCOs, therefore, also describes the potential for energy efficiency investment by other means, be they ratepayer-funded DSM programs or other energy service providers including mechanical contractors and companies that specialize in installing onsite generation. In 2015, utilities or third-party administrators of ratepayer-funded gas and electric efficiency programs in the U.S. spent more than \$3 billion on gas and electric efficiency at commercial and industrial facilities (CEE 2017). Note that this total represents the program administrator cost and does not include the customer's cost contribution for installed measures in these programs. The comprehensiveness of these programs varies by state and administrator, but in general, they offer a range of opportunities for investments in efficiency that rely on financial incentives (e.g. rebates) that may be leveraged by various types of energy efficiency service providers. ESCO projects often leverage financial incentives from these programs to reduce the amount of project capital that is ultimately financed. However, utility efficiency programs (e.g. rebates) are often quite compatible with the way that HVAC and lighting contractors approach customers and thus potentially compete with ESCO service offerings.

Lower retail energy, electricity, and water prices

Government facility managers seek energy price certainty for budgeting purposes and they have used the fixed price payments for ESPCs to, in effect, partially hedge against variable or higher future rates for electricity, gas, and water. Performance contracts typically stipulate energy cost escalations over the life of the contract (e.g., 2-3% annually) and higher projected cost escalations translate into more dollar value savings that can justify larger project investments. However, expectations that future electricity, gas and/or water rates will not increase much over time or increase at rates that are less than the inflation rate could limit the amount of energy price escalation that customers feel comfortable stipulating in contracts. This would have the effect of reducing the total project investment that can be repaid from energy savings (Stuart et al. 2016). Expectations of persistently low energy, electricity, and/or water prices could reduce the remaining market potential significantly.

- c. Other factors that have an *unknown* influence on market potential

This analysis presents the investment potential for infrastructure improvements based on the

total square footage of buildings and market sectors historically served by ESCOs. We do not make assumptions about reasons other than the barriers addressed above as to why some of the floor area considered in our analysis may not be addressable (e.g., building removal, unused floor space, unavailable to retrofit for other reasons). The U.S. Department of Defense, for example, submits detailed sustainability targets via an annual *Strategic Sustainability Performance Plan—SSPP* (U.S. Department of Defense 2017). Target-levels within the SSPP—or within planning documents produced at other local/state/federal agencies—may consider the possibility that many “low-hanging” facility retrofit opportunities may already have been completed. We also know that the floor area estimates underlying our base case may under-count (or over-count) the actual amount of floor area across the country. For example, the 2015 Federal Real Property Report does not report floor area for all military facilities, especially facilities that are critical to national security (GSA 2016). In addition, regular updates to and proper enforcement of energy codes and standards raise the baseline level of efficiency of new construction projects and the minimum efficiency level of future retrofits. On the other hand, updates to building codes and standards may, in some cases, necessitate the need for additional retrofits in existing buildings. Finally, ESCOs have also shown interest in developing projects in non-building applications including, but not limited to retrofitting aircraft, vehicles, and ships maintained by the U.S. Department of Defense (FEMP 2014).

Market potential does not always translate into industry growth

In our estimates of aggregate market potential for ESCOs, we do not make assumptions about how quickly the building stock can be addressed feasibly, given ESCOs’ current staffing levels or ability to staff up to meet the potential. It has been documented that ESCOs have been overly-optimistic about industry growth potential in the past (e.g., see Satchwell et al. 2010; Stuart et al. 2014; Stuart et al. 2016).

4. Results

Tables 2 through 4 contain more detailed information on the base case addressable floor area and project installation costs as well as the impact of unfettering the industry from market, bureaucratic, and regulatory barriers. Figure 3 shows the low and high remaining market potential under both the base case and unfettered case.

Table 2. Addressable floor area in the base and unfettered case (billions of ft²)

Market Category	Base Case (billions of ft ²)	Reduction of...					Unfettered Case: Additional Floor Area	Unfettered Case: Total Floor Area (billions of ft ²)
		Market Barriers		Bureaucratic Barriers	Regulatory Barriers			
		Building size	New markets	Appropriations	O&M	Contract Length		
Federal	1.4	+0.2	0	0	0	0	+0.2	1.6
State/Local government	3.7	+1.4	0	0	0	0	+1.4	5.2
Healthcare	3.2	+0.2	0	0	0	0	+0.2	3.4
K-12 Schools	4.9	+0.1	0	0	0	0	+0.1	5.0
University/Colleges	0.9	+0.1	0	0	0	0	+0.1	1.0
Public housing	3.9	0	0	0	0	0	0	3.9
Private	8.2	+0.9	+12.1	0	0	0	+13	21.2
Total	26.3	+2.9	+12.1	0	0	0	+15.0	41.3

Table 3. Low estimate of project installation costs under the base and unfettered case (\$2016 per square foot)

Market Category	Base Case (\$ per square foot)	Reduction of...					Unfettered Case: Additional Investment (\$ per square foot)
		Market Barriers		Bureaucratic Barriers	Regulatory Barriers		
		Building size	New markets	Appropriations	O&M	Contract Length	
Federal	\$2.1	+\$0.3	0	+1.6	+\$0.4	+\$1.2	+\$3.5
State/Local government	\$4.5	+\$1.2	0	0	+\$1.5	+\$1.3	+\$4.1
Healthcare	\$3.6	+\$0.2	0	0	+\$1.6	+\$3.4	+\$5.2
K-12 Schools	\$3.6	+\$0.1	0	0	+\$1.8	+\$0.7	+\$2.6
University/Colleges	\$3.0	+\$0.3	0	0	+\$0.5	+\$1.1	+\$1.8
Public housing	\$4.2	0	0	0	+\$1.0	0	+\$1.0
Private	\$2.9	+\$0.1	+\$0.8	0	+\$0.7	0	+\$1.7

Table 4. High estimate of project installation costs under the base and unfettered case (\$2016 per square foot)

Market Category	Base Case (\$ per square foot)	Reduction of...					Unfettered Case: Additional Investment (\$ per square foot)
		Market Barriers		Bureaucratic Barriers	Regulatory Barriers		
		Building size	New markets	Appropriations	O&M	Contract Length	
Federal	\$6.2	+\$0.9	0	+\$1.6	+\$0.4	+\$1.2	+\$4.1
State/Local government	\$9.8	+\$2.7	0	0	+\$1.5	+\$1.3	+\$5.5
Healthcare	\$9.4	+\$0.5	0	0	+\$1.6	+\$3.4	+\$5.5
K-12 Schools	\$8.7	+\$0.2	0	0	+\$1.8	+\$0.7	+\$2.7
University/Colleges	\$7.3	+\$0.7	0	0	+\$0.5	+\$1.1	+\$2.2
Public housing	\$6.4	0	0	0	+\$1.0	0	+\$1.0
Private	\$6.2	+\$0.3	+\$1.8	0	+\$0.7	0	+\$2.8

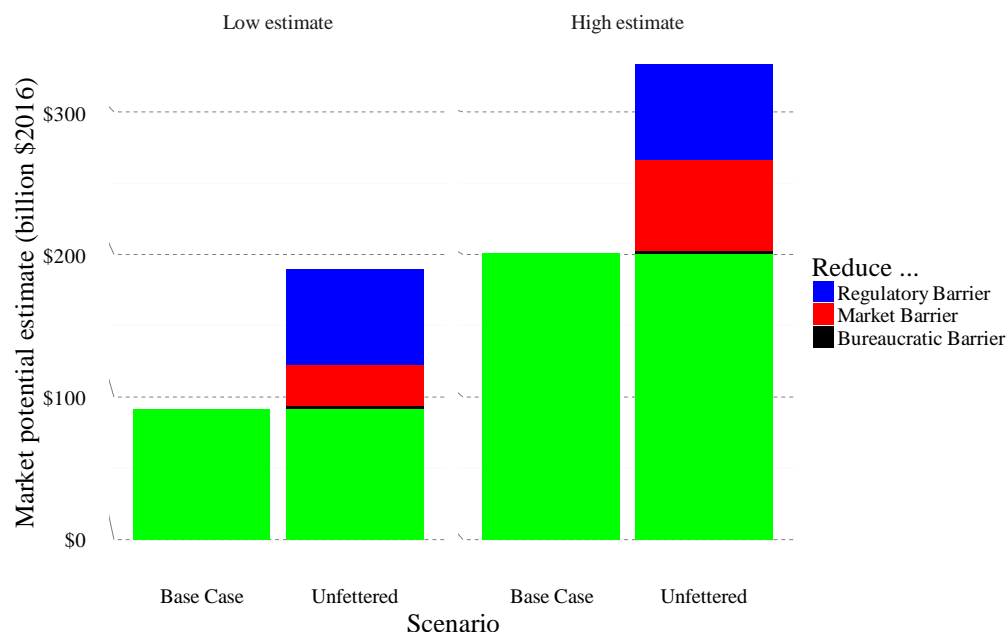


Figure 3. Remaining market potential under the base and unfettered cases

We estimate that remaining market potential for the U.S. ESCO industry ranges between \$92-201 billion (\$2016) in the base case. In the “unfettered” case, we estimate that remaining market potential for the U.S. ESCO industry ranges between \$190-333 billion. Table 5 contains the base and unfettered case estimates of remaining market potential by market category. Comparing the base vs. unfettered case, upside market potential for ESCOs is most pronounced in the private sector market, followed by state/local government market in terms of absolute dollars.

Table 5. Remaining market potential by market category for base and unfettered cases (billions of \$2016)

Market Category	Base case (billions of \$2016)		Unfettered case (billions of \$2016)	
	Low	High	Low	High
Federal	\$3	\$9	\$9	\$15
State/Local government	\$17	\$37	\$39	\$65
Healthcare	\$11	\$30	\$30	\$49
K-12 Schools	\$18	\$43	\$32	\$56
University/Colleges	\$3	\$7	\$6	\$9
Public housing	\$16	\$25	\$21	\$29
Private	\$23	\$51	\$60	\$110
Total	\$92	\$201	\$190	\$333

This report is an attempt to update and enhance our initial estimates of remaining market potential for ESCOs. In the future, we hope to explore alternative methods to estimate remaining market potential for this important industry.

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