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A method to estimate the size and remaining market potential of the U.S. energy service company (ESCO) industry

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1. Introduction

A significant ramp-up in U.S. energy efficiency activities is occurring at the local, state, and federal level, driven in part by the adoption of energy efficiency or greenhouse gas reduction goals. For example, in the utility sector, the number of states with binding energy saving targets increased from seven in 2008 to 21 at present. 15 U.S. states have adopted energy efficiency resource standards (EERS) that require program administrators at utilities or other entities to achieve minimum energy savings targets that increase in the future (e.g., annually over the next 10 years). Six additional U.S. states have established statutory or regulatory requirements that utilities acquire “all cost effective” energy efficiency.¹ In response to a 2011 presidential memorandum the U.S. Department of Energy (DOE) was tasked with implementing \$2 billion (\$US) in new energy savings performance contracts (ESPCs) and utility energy savings contracts (UESCs) in 2012 and 2013. If successfully implemented, this authorization represents a significant increase in U.S. federal market activity compared to previous years.²

This study presents a method to estimate the market investment potential for energy-saving performance contracts (ESPC) and annual blended energy savings remaining in buildings typically addressed by U.S. ESCOs. The energy service company (ESCO) industry has a well-established track record of delivering substantial energy and economic savings in the public and institutional buildings sector, typically through energy saving performance contracts (ESPC) [1,2,3].

Larsen et al. [2] formally define an Energy Service Company (ESCO) as: “*A company that provides energy efficiency-related and other value-added services and for which performance contracting is a core part of its energy-efficiency services business. In a performance contract, the ESCO guarantees energy and/or dollar savings for the project and ESCO compensation is therefore linked in some fashion to the performance of the project*”.³

This work builds on previous Lawrence Berkeley National Laboratory (LBNL) U.S. ESCO industry research that includes analysis of information from a database of over 4,000 completed energy savings performance contract (ESPC) projects [1,2] and previous research drawing upon interviews with ESCO executives [2,4]. We analyze the market size, recent growth trends and market characteristics of the U.S. ESCO industry and provide a preliminary estimate of the remaining ESCO industry market potential (expressed in terms of investment opportunity and projections of potential energy savings) using a methodology we developed to accommodate data limitations.

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¹ Conceptually, “all cost-effective” efficiency means the maximum amount of energy efficiency resources that can be obtained that meet the state’s cost-effectiveness analysis. Specific cost-effectiveness tests and application of those tests vary by state.

² For example, the total dollar energy efficiency investment allocated through the Federal Energy Management Program’s Super ESPC Program--since its inception fifteen years ago--totals \$2.7 billion.

³ This definition aligns with the European Commission Directive (2006/32/EC) on Energy End-use Efficiency and Energy Services standard definition of an ESCO, in particular the delivery of energy services and that some degree of performance-based financial risk is held by the ESCO [9,10].

This work is intended to inform federal, state and local policymakers, ESCO industry executives, other energy efficiency service providers, and end users in the institutional and commercial market in the U.S. and other countries with growing ESCO industries. In addition, the method and results discussed here (i.e., current market size and remaining dollar and savings potential) could be used directly (or adapted) by other researchers [5,6,7,8] to estimate local, regional, or global demand for energy efficiency services. In section 2, we introduce our estimation method and data sources. Section 3 provides findings on ESCO market size, growth, industry characteristics and the global context. Section 4 presents results of our estimate of the remaining U.S. ESCO market potential. Section 5 discusses the U.S. ESCO industry in a global context. In Section 6, we summarize findings and discuss limitations of the market potential estimation methodology.

2. Data Sources and Estimation Methods

In this section, we discuss data sources and methods used to estimate 1) 2011 U.S. ESCO industry revenues and growth trends; and 2) the remaining U.S. ESCO industry market potential.

To establish the boundaries of what we define as the ESCO industry, we included only those companies that meet our definition of an ESCO: *firms for which performance contracting is a core part of their energy-efficiency services business*. We did not include companies such as engineering and architectural firms; HVAC, lighting, windows or insulation contractors; companies whose primary business is utility energy efficiency program implementation; and consultants that offer energy efficiency services, but typically do not enter into long-term contracts that link compensation to the project's energy savings and/or performance. We also excluded companies that provide primarily on-site generation or renewable energy systems without also deploying energy efficiency measures.

2.1 ESCO Industry Interviews

A primary source of information for this study was a set of interviews conducted with U.S. ESCOs in the summer and fall of 2012. ESCO executives were asked to provide information about their company's 2011 revenue from energy services, past and projected revenue growth rates and revenue by market segment, contract type and technology type. We defined energy services to include performance contracts, energy efficiency and/or onsite generation, design/build projects, engineer/procure/construct projects, and energy efficiency-related consulting. For purposes of this report, the definition of energy services excluded retail commodity sales or projects built to supply power to wholesale markets. ESCOs also provided market penetration estimates of performance-based energy saving projects for each customer market segment for their service area.

The following sources of information were used to develop the initial list of companies that might be considered ESCOs for the purposes of this study:

- ESCOs accredited by the National Association of Energy Service Companies (NAESCO);
- U.S. DOE list of qualified energy service companies;

- Members of the Energy Services Coalition (ESC) that indicated providing performance contracting;
- Qualified ESCOs identified through state performance contracting programs (Arizona, Colorado, Delaware, North Carolina, Oregon, Wyoming); and
- Online research to identify other companies who might be engaged in performance contracting.

To identify the list of companies that qualify as ESCOs under our definition, we identified an initial list of 144 companies that provide energy efficiency services, including, potentially, performance contracting. We then conducted additional research, consulted with NAESCO staff, conducted a Delphi⁴ process with several industry experts, and directly contacted companies to narrow the list to only those companies that appeared to meet our specific definition of an ESCO. Finally, through the interviews with ESCO executives and the Delphi process, we identified 45 ESCOs that met our criteria and were actively working within the United States. We were able to interview 35 of the 45 companies; thus the response rate among ESCOs was about 78%.

2.2 Estimating U.S. ESCO industry size and projected growth

We estimated aggregated 2011 ESCO industry revenue from energy services by summing revenues reported by the 35 ESCOs we interviewed and revenues estimated for the 10 ESCOs that did not respond to our requests. ESCO revenues from the latter group of companies were estimated through a Delphi approach with industry experts, informed by consulting recent publicly-available information (e.g., company reports, U.S. Securities and Exchange Commission 10-K filings). The ten non-respondent ESCOs were among the smallest ESCOs in terms of revenue, ranging from \$1M to \$20M revenue annually. In aggregate, we estimate that the non-respondent ESCOs represented about 2% of 2011 ESCO industry revenues in the U.S. For ESCOs that are part of a larger organization, the revenues reported in this study are derived exclusively from the business unit providing ESCO-related services. See Figure 1 for a flowchart of data sources and methods for estimating U.S. ESCO industry revenues for 2011.

We developed an aggregate estimate of projected industry revenues through 2014 by using (1) respondent ESCOs' growth projections applied to their 2011 revenues and (2) median industry-wide growth rates for the non-respondent ESCOs—applied to the their Delphi-generated revenues. We estimated projected growth rates for non-respondent ESCOs by calculating median growth rates for the respondent ESCOs across three size categories: small (2011 revenue <\$100M US), medium (2011 revenue \$100M-\$299M) and large companies (2011 revenue >=\$300M).⁵ We applied these median growth rates to non-respondent ESCO revenues of the corresponding sizes to determine the 2012-2014 revenue projections.

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⁴ A Delphi technique is a process used in business forecasting to reach a consensus via the solicitation and comparison of the views of a small group of experts [11]. Patari and Sinkkonen [12] used a Delphi approach to evaluate the ESCO business model using a group of industry experts in Finland.

⁵ All dollar amounts throughout this article are U.S. 2012 dollars unless otherwise indicated.

On average, small ESCOs projected a 15% annual growth rate for the three years 2012-2014, while on average, medium and large ESCOs projected 10% and 7% annual growth rates, respectively (see Table 1).

2.3 Estimating ESCO industry remaining market investment and savings potential

Stuart et al. [14] summarizes the literature which indicates that there are several different types of energy efficiency “potential” and definitions of several key terms including: 1) *technical* potential (the theoretical maximum amount of energy savings that could occur disregarding all non-technical constraints such as cost-effectiveness and end-user willingness to adopt measures); 2) *economic* potential (the subset of technical potential of those measures that are cost-effective when compared to the price of conventional energy supply); and *achievable* potential (the subset of economic potential that could be achieved over time under the most aggressive energy efficiency program scenario possible).

Our estimate of ESCO market potential is somewhat similar to an achievable potential in that we utilize typical installation costs, energy savings and dollar savings based on actual projects in the LBNL/NAESCO project database.⁶ Our estimate of total floor area available in the ESCO market relies on buildings data from several sources including the U.S. Energy Information Administration (EIA); the U.S. General Services Agency (GSA); the U.S. Department of Housing and Urban Development (HUD) and the Council of Large Public Housing Authorities (CLPHA). Unfortunately, we do not have enough information to determine what percentage of that floor area is economically feasible for ESCOs (or their customers) to retrofit. Accordingly, we developed an analytical approach to accommodate these data limitations.

We define the remaining investment potential for markets typically served by ESCOs as the aggregate amount of project installation costs technically possible with a single turnover of the remaining stock of buildings not already addressed by ESCOs⁷. In other words, investment potential represents the upper-bound dollar amount that ESCOs could achieve in markets typically addressed by this industry. Our estimate excludes two factors that could result in a significantly greater potential market: (1) the impact of new technologies that are more cost effective than current technologies; and (2) another round (or two) of projects implemented in buildings whose retrofits are now beyond their expected useful life.

Equations 1-4 describe the method used to estimate remaining potential (MP) for market segment i in investment dollars (INV) and annual energy savings (ESAVE), respectively:

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⁶ LBNL, in collaboration with NAESCO, has developed and maintained a database of performance-based energy projects implemented from the late 1990s to the present. As of May 2013, the database contained more than 4,200 energy efficiency-related projects in 49 states and several foreign countries. Most of the projects in the database are self-reported submissions by individual ESCOs as part of NAESCO’s voluntary accreditation process [2]. Information provided by ESCOs includes, but is not limited to: facilities information (e.g., floor area, number of buildings, location); baseline energy consumption; contract information; measures installed; market segment; project investment levels; and projected, guaranteed, and measured savings.

⁷ It is important to note that this preliminary estimate is based on assumptions of (1) existing market penetration provided by the ESCOs and industry experts and (2) data on the population of U.S. commercial buildings as reported by CBECS, RECS, HUD, or GSA.

$$MP\_INV_i = (1 - PEN_i) \times (BPOP_i) \times (INV_i) \quad (1)$$

$$MP\_SAVE_i = (1 - PEN_i) \times (BPOP_i) \times (ESAVE_i) \quad (2)$$

where i is market segment (as listed in Table 2); PEN_i is market segment penetration (%) from 2003-2012; $BPOP_i$ is aggregate floor area of buildings (m^2) in 2003; INV_i is typical investment level per square foot (\$2012/ m^2) from 2003-2012; and $SAVE_i$ is typical annual energy savings per square foot (MMBtu/ m^2) from 2003-2012.

It follows that aggregate ESCO industry potential (EIP) is the summation of the potential for all seven market segments (as listed in Table 2) for each ESCO market potential metric (investment dollars and annual energy savings):

$$EIP\_INV = \sum_{i=1}^7 MP\_INV_i \quad (3)$$

$$EIP\_SAVE = \sum_{i=1}^7 MP\_SAVE_i \quad (4)$$

We developed the estimate of remaining ESCO investment potential in four basic steps:

- 1) Estimate total floor area of ESCO-addressable buildings by market segment;
- 2) Determine existing market penetration of non-residential performance-based energy efficiency retrofits in ESCO markets;
- 3) Calculate typical investment levels and energy savings for the various market segments; and
- 4) Estimate remaining market potential (see Figure 2).

Step 1: Estimate Total Floor Area of Buildings Typically Addressable by ESCOs

Step 1 involved compiling information on the population of U.S. buildings and total floor area (m^2) for each market segment using data from the EIA Commercial Building Energy Consumption Survey (CBECS) [15] and Residential Energy Consumption Survey (RECS) [16], the U.S. GSA [17], HUD [18], and CLPHA [19].⁸

The 2003 CBECS contains 5,215 records, which represents a statistically representative sample of U.S. commercial buildings. Each record corresponds to a single sampled building from across the country. The survey results are then weighted to derive the entire stock of commercial

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⁸ The CBECS database defines a “commercial” building as any building that is neither residential (used as a dwelling for one or more households), manufacturing/industrial (used for processing or procurement of goods, merchandise, raw materials or food), nor agricultural (used for the production, processing, sale, storage, or housing of agricultural products, including livestock).

buildings in the U.S. (i.e., population of commercial buildings). The U.S. DOE Buildings Energy Data Book provides a query tool to access CBECS micro data [20]. Table 2 presents the query parameters that we used to compile the total floor area of “ESCO-addressable” buildings by market segment.

We explicitly attempted to account for the notion that, for various reasons, not all buildings in a market segment are addressable by ESCOs. For example, we know that ESCOs often target facilities of a certain minimum size, given that there are significant transaction costs involved in performance contracting. Accordingly, we assumed public buildings with total floor area larger than 4,645 m² to be ESCO-addressable. We considered private commercial buildings to be ESCO-addressable if they were greater than 4,645 m² *and* owner-occupied, as principal-agent issues create high barriers to completing energy efficiency upgrades in leased buildings [21].

We estimated the total floor area of public housing likely to be addressable by ESCOs by compiling information from two sources and making several assumptions about this population of buildings. We used project-level information from the LBNL/NAESCO database to estimate median public housing unit investment levels of \$58.56/m². Next, we compiled information on public housing development size and unit counts from the Council of Large Public Housing Authorities (CLPHA) and the EIA's Residential Energy Consumption Survey (RECS). We found that there were a total of 1,164,972 public housing units in 2000. We multiplied the number of units by the per-unit average square footage (84 m²) for public housing units from the RECS. This resulted in an estimate of ~98 million m² of ESCO-addressable public housing living space.

We used two sources of information to estimate the total floor area of federal facilities in 2003. It appears that the CBECS survey may have under-estimated the floor area of federal facilities. We believe that GSA estimates of floor area for federal facilities are more accurate, because GSA provides a comprehensive inventory of federal facility information. Unfortunately, the overall share of facilities with a floor area greater than 4,645 m² was not specified. In this case, we used the share of federal floor area greater than 4,645 m² from CBECS and multiplied this value by the aggregate floor area reported by GSA to determine the total floor area of federal facilities larger than 4,645 m².

Table 3 presents our results for total floor area of ESCO-addressable buildings, incorporating results from the CBECS database query and our calculations of federal and public housing floor area.

Step 2: Estimate ESCO Market Penetration

Step two relies on ESCO industry respondents' estimates of market penetration and the judgment of our ESCO industry experts. We asked ESCO executives to estimate the percentage of the market in the ESCOs' service area, for each market segment, that has received energy efficiency services provided by any ESCO or other type of service provider at least once since 2003. For the purposes of this report, we estimated the remaining market potential for performance-based contracting, and thus only include ESCO market penetration estimates for performance-based projects. Twenty-one ESCOs provided market penetration estimates. The respondent ESCOs represented approximately 50% of the ESCO market in terms of industry revenues and included

both small and large companies.⁹ We applied each ESCO's market penetration estimates across each of the U.S. Census regions included in that ESCO's service area. We then calculated the median of all ESCO responses that occurred for each market segment and each U.S. Census region (see Table 4).

We multiplied the market penetration estimates by the aggregate floor area of each market segment to convert market penetration estimates to floor area that has received a performance contracting retrofit since 2003. We then summed the results to arrive at a total floor area for all market segments. Table 5 shows the total estimated floor area of ESCO-addressable buildings that have received performance-based retrofits since 2003, and indicates the percentage of the total floor area addressed by performance-based retrofits that is attributable to each market segment.

Step 3: Typical ESCO Project Investment and Savings Levels

Step three involved analyzing ESCO project information for installations completed from 2003 to 2012 using data from the LBNL/NAESCO database. We calculated median and average (i.e., "typical") dollar investment level per square foot and annual energy savings per square foot—disaggregated by the seven market segments. See Appendix A of Larsen et al. [2] for additional information about data sources, analysis methods, and quality assurance processes for the LBNL/NAESCO project database.

ESCO projects, across all market segments, tend to be bifurcated into two distinct groupings: (1) projects that have low-to-medium installation costs per square foot and (2) projects that have extremely high installation costs per square foot (often because these projects install onsite generation or renewable energy systems or install expensive measures (e.g. new roof) that augment installation of energy-related measure. This bifurcation leads to significant differences between the median and average values calculated for projects in the LBNL/NAESCO database. Figure 3 depicts the frequency of project investment levels (i.e., installation costs per square foot) for K-12 schools; other market segments exhibit a similar pattern (see Figure 4). Therefore, we report the market potential results as a range between a low estimate (median value from database of projects) and high estimate (average value from database) for the typical range or project investment levels.

Table 6 summarizes study assumptions for median and average ESCO project investment levels (i.e., project installation costs) and annual energy savings for retrofits completed from 2003 to 2012 normalized by floor area.

Step 4: Estimate Remaining Investment and Savings Potential for Markets Typically Served by ESCOs

Step four involved estimating total remaining ESCO market potential for each market segment. We multiplied total ESCO-addressable floor area (from step 1 above) by typical project cost

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⁹ We analyzed market penetration responses by size of ESCO and detected no observable difference between the responses of the smaller and larger ESCOs.

(\$/m²) and annual blended energy savings (MMBtu/m²) to determine total ESCO market size in terms of dollar value of investment opportunity and annual energy savings. Next, we multiplied total floor area that has been addressed (from step 2) by typical project cost (\$/m²) and annual energy savings (MMBtu/m²) to estimate the size of the market already addressed by retrofits in terms of dollar value of investment opportunity and annual energy savings. Finally, we calculated the difference between total investment opportunity and the portion of this opportunity already addressed to arrive at our estimate of remaining per-market (and total industry) investment potential. We report the results as a range between a *low* estimate (median installation cost or savings per square foot value from LBNL/NAESCO database of projects) and *high* estimate (average value from database).

3. U.S. ESCO Industry Size, Growth and Market Characteristics

3.1 Revenues and Growth Trends

We estimate that aggregate ESCO industry revenue was about \$5.3 billion in 2011; energy efficiency projects accounted for about 85% of revenue. In comparison, Satchwell et al. [13] estimated 2008 ESCO industry revenue to be about \$4.1 billion (in nominal terms). Thus, we estimate that the U.S. ESCO industry grew about ~9% per year between 2009 and 2011. These results suggest that the ESCO industry has maintained relatively steady growth in recent years despite the severe economic recession which began in 2008-2009 (see Figure 5).

As discussed earlier, we developed an aggregate estimate of projected U.S. ESCO industry revenues for 2012-2014 by applying each ESCO's reported growth projections to their 2011 revenues. We found that the U.S. ESCO industry anticipates annual revenues of approximately \$7.5 billion through 2014, which represents an average annual growth rate of ~12% over the three year time horizon (see Figure 5).

It is important to recognize that ESCO industry revenues grew at a significant rate between 2009 and 2011 (approximately 9% annually in nominal terms), much faster than U.S. Gross Domestic Product (GDP), which grew an average of 1.9% annually during that same period [22].

Many factors may positively (or negatively) impact the future revenue trajectory of the ESCO industry; we highlight several factors that may contribute positively to ESCO industry revenue over the longer term.

Opening up of new markets. Historically, ESCOs have provided energy efficiency performance contracting primarily to existing facilities. In Canada, K-12 schools are beginning to include new construction in performance contracts with performance tied to incremental savings of the energy efficient technologies. If this market opens up to ESCOs in the U.S., it could be an important driver of new business. The continued expansion of demand response opportunities in organized wholesale markets (e.g. capacity markets in PJM, NYISO, ISO-NE) provides another market opportunity for ESCOs to coordinate energy efficiency, demand response and onsite generation service offerings.

Greater penetration in existing market sectors. The emergence of commercial property-assessed clean energy (PACE)¹⁰ programs and on-bill repayment programs¹¹ may lead to new opportunities for ESCOs (including other new entrants that offer performance-based services) to expand their reach in the private sector commercial market. At least one PACE program (Ann Arbor, Michigan), requires performance contracts for projects over \$250,000 [14]. Given the remaining market potential in this customer segment (see section 4), the ability of ESCOs to successfully develop projects in this sector could be a major market driver in the future.

Additional revenue from non-energy services. Performance contracts can include non-energy services such as water conservation measures and infrastructure improvement (e.g., K-12 asbestos abatement, wiring, and roof replacement). Industry experts we spoke with expect that additional non-energy technologies (e.g., security measures, fiber-optic cables) may become more common, potentially increasing project investment levels in some institutional markets.

Policy drivers. It has been shown that the adoption of clean energy policies are the major driving forces of the “green” business development in the U.S. states [23]. Not surprisingly, enabling policies have played an important role in the development and maturation of the ESCO industry (e.g., legislation that allows long-term performance contracts in institutional markets). More recent examples include cities that have enacted building energy benchmarking and energy use disclosure policies which may help to spur energy efficiency activity in the commercial/institutional market, state and local governments adopting energy efficiency goals, or the possibility of federal climate-related legislation, rulemakings or policies that encourage cost-effective energy efficiency investments.

3.3 Revenue by Customer Market Segment

ESCOs reported their 2011 revenues by customer market segment, which are summarized in Table 7 below. Key findings are as follows:

- 84% of ESCO revenues in 2011 came from the public and institutional sector, which includes the federal government. Federal, state, and local government energy use reduction goals are a driver in the use of ESPCs on large projects that are authorized to have contract terms of up to 20 years.
- The “MUSH” markets (state and local government entities, universities/colleges, K-12 schools, and healthcare facilities), represented about 64% of industry revenue in 2011.

Barriers to implementing comprehensive energy projects in private commercial facilities remain high [21] and private sector projects accounted for just over 8% of ESCO industry revenues in

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¹⁰ Commercial PACE legislation authorizes local or statewide taxing districts that enable financing of energy efficiency improvements in public, institutional and commercial facilities. The amount financed is assessed to the property, and property owners repay the project costs via their property tax bills, allowing the costs of efficiency improvements to be repaid over a longer period of time than normally possible through a commercial loan.

¹¹ On-bill repayment programs may offer low or zero percent financing, for energy efficiency projects which are repaid on the customer’s utility bill. In some cases, the payments can be less than the monthly dollar savings from the energy efficiency measures, allowing project costs to be fully paid out of the savings.

2011. ESCOs report that private sector companies in the U.S. are generally averse to financing energy efficiency work, as well as to allocating capital expenditures for energy projects that have relatively long payback times. One ESCO that primarily serves publicly-held private sector customers reported that these companies typically prefer to pay cash for energy efficiency projects, rather than financing them. The ESCO reported that its private sector customers were only interested in pursuing projects with extremely short payback times (one to two years).

3.4 Revenue by Business Activity

ESCOs also reported 2011 revenues by type of business activity or project contract type. Performance-based contracting has remained a consistent and dominant contracting vehicle, accounting for 69% of 2011 revenues, or about \$3 billion (see Figure 6)—which is comparable to similar market shares of 69% and 70% in 2008 and 2006, respectively [13]. Design/build projects comprise the next largest share of 2011 revenue (15% or about \$660 million), followed by utility program administration (7%), consulting (3.9%) and onsite generation power purchase agreements (3.6%).¹²

3.5 Revenue by Technology and Project Type

Figure 7 presents reported U.S. ESCO revenues by technology/project type for 2008 and 2011. Not surprisingly, energy efficiency comprised nearly three-quarters (about \$3.3 billion) of 2011 ESCO industry revenue. Renewable technologies and operations and maintenance (O&M) contracts (5.7% and 4.8%, respectively) were the most prevalent of the other categories.

Onsite generation was 3.6% of business activity (see Figure 6) because that revenue is specifically attributed to power purchase agreements (PPA). However for the share of revenue by technology or project type (Figure 7), renewable technologies (5.7%), includes revenue from PPAs as well as other types of contracts.

Satchwell et al. [13] and Larsen et al. [2] observed that onsite generation projects became more prevalent in the ESCO industry from 1990-2008.¹³ However, in our 2012 interviews with ESCOs, they reported that both total and relative share of revenues from onsite energy installations declined between 2008 and 2011. ESCOs reported that onsite renewable energy projects comprised about 15% of industry revenue in 2008 (~\$565 million with 29 ESCOs responding) [13], while we found that onsite renewable energy projects generated ~5.7% of industry revenues in 2011 (~\$250 million with 34 ESCOs responding). Similarly, we observed a

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¹² Design/build projects refers to fee-based contracts that may include such services as engineering, procurement, project installation and construction; ESCOs do not guarantee energy savings or assume long-term performance risk in these projects. Consulting contracts can include a wide range of activities including audits, engineering studies, project and subcontractor management. Some ESCOs manage or implement programs for utility energy efficiency programs, most commonly in the small commercial or commercial/industrial sector, but occasionally in the residential sector as well. Under a PPA, a third-party (e.g., ESCO) installs and operates an onsite energy generation system and sells the generated energy to the customer.

¹³ For example, from 1990-1997 only 5% of public sector ESCO projects in the LBNL ESCO database included onsite generation. However, the share of public sector projects in the database that included onsite generation roughly doubled during the 2005-2008 timeframe (to 11%).

decline in share of revenues from engine/turbine technology from 6% in 2008 (\$233 million) to 3% in 2011 (\$130 million).

During the period 2008-2011 the renewable energy industry continued to expand and grow: for example, in the non-residential market, PV installations increased from about 250 MW in 2009 to 800 MW in 2011 [14]. However, the shift away from renewables in ESPC projects developed by ESCOs may be attributable to several factors. First, there has been a proliferation of companies that specialize in onsite renewable electricity generation, which may be gaining market share against ESCOs. Second, ESCOs do not typically specialize in the manufacture of onsite renewables, which may place them at a disadvantage compared to solar companies that are vertically integrated. Third, incentives to install onsite renewable electricity systems (e.g. solar) have decreased over the last several years and state renewable energy credit (SREC) prices declined dramatically in many states [24]. Lower SREC prices may make implementing solar projects less attractive to some ESCOs, given that a comprehensive retrofit project that might not otherwise be viable can be made cost-effective when SRECs are generated and transferred to the project developer who can sell them.

Finally, many MUSH and federal and state government customers may have expressed preferences in their solicitations for the inclusion of renewable technologies in a comprehensive ESCO-delivered energy savings performance contract project. However, in practice, there is anecdotal evidence to suggest that, in some cases, customers have then cut back and “descoped” the renewable measures from the project, primarily driven by preference for a shorter payback period.

4. Remaining ESCO Market Potential

Table 8, below, shows that the *remaining* market potential for the U.S. ESCO industry in terms of project investment opportunity ranges from a low estimate of about ~\$71 billion to a high estimate of \$133 billion. The large amount of remaining investment potential is indicative of a ~25% average market penetration rate across all U.S. market segments. This preliminary analysis found that there is still a considerable opportunity for ESCO activity in all market segments.

Figure 8 shows that the private commercial building sector has the largest remaining market potential (~\$14 to \$34 billion). However, as discussed earlier, there have been barriers for ESCOs interested in pursuing this market (e.g., shorter payback requirements of customers).

Table 9 shows that the remaining annual energy savings potential for the U.S. ESCO industry ranges from about ~354 trillion to ~519 trillion Btu. The private commercial sector has the largest remaining potential (128-188 trillion Btu) despite the K-12 schools segment having the largest total market size.

5. U.S. ESCO Industry in a Global Context

Outside of the United States, ESCO industry development continues at a steady (or high-growth) pace. Some countries define ESCOs in a similar fashion and report that these companies were first introduced into Asia in the 1990s—based in part on the U.S. business model [25]. Nakagami

reported that China's performance contracting market totaled just over \$1.6 billion in 2008 [25] and Kostka and Shin [26] indicate that the ESCO market in China grew to \$4.4 billion in 2009. A 2012 report from EMCA and ICF found that China's performance contracting industry had grown to \$5.5 billion in 2011 [27].¹⁴ However, other researchers suggest that the Chinese ESCO business model has "serious limitations and is unlikely to lead to large-scale implementation of energy efficiency projects in China" [26]. Japan, the next largest market for ESCOs in Asia, was a distant second with revenue of ~\$374 million in 2011 [28].

In contrast, ESCOs have a longer history in some European countries [29], with widely varying development rates among various countries [30]. Okay and Akman explored the relationship between ESCO Indicators (e.g., age of the ESCO market, number of ESCO companies) and Country Indicators (e.g., per-capita GDP) in order to estimate the total value of ESCO projects in 38 countries [31]. Bertoldi et al [32] have developed new estimates of ESCO industry size in some European states, based on a 2012 global survey of ESCO industry executives.¹⁵ Marino et al. [10] also examined the development of the ESCO industry from 2007-2010 across the European Union. The authors abided by the European Parliament's Energy Services Directive by defining an ESCO as a legal entity (or person) that delivers energy services and/or efficiency improvements using a performance-based approach, taking on some degree of financial risk.

Table 10, below, depicts industry size estimates from these various reports, as compared to our U.S. findings. The largest ESCO industries in the European Union, are France (~\$4-\$5 billion in 2010) and Germany (~\$4-5 billion in 2012) and are on par with the U.S. ESCO industry in terms of annual revenues. There are ~10 large and ~100 smaller ESCOs operating in France. Germany's industry was comprised of ~200-500 ESCOs. Similar to the United States, both France and Germany's ESCO industries have experienced steady growth [3,10]. Other European and Asian countries' markets, excluding China, are approximately one-tenth the size of the leading countries or smaller. However, several smaller European markets (e.g., Denmark, Romania) are reporting high growth rates.

Although ESPCs are making inroads in these markets, many European countries (e.g., France, Italy, U.K., Spain and Switzerland) typically use the "chauffage" financial model [3,10] which differs from the dominant contractual approaches used by U.S. ESCOs (i.e., guaranteed savings). In the chauffage business model, ESCOs *supply* energy and provide long-term O&M services, in addition to managing demand-side efficiencies. ESCOs implement energy efficiency projects at customer facilities and borrow a majority of the project costs from lenders. ESCOs profit from retaining the difference between the customer payments for delivered energy and other services and loan payments to the lender. Furthermore, several countries in Asia report that ESCOs "share savings" with customers [33, 34]. The shared savings model is a fundamentally different business model than what is typically found in the U.S. ESCO industry where excess savings are paid to the customer [2]. Unfortunately, differences in revenue reporting, allocation of savings, and the definition of an ESCO make it difficult to compare the size of this industry across countries. Despite these differences, the analytical technique we demonstrate in this paper could

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¹⁴ This figure only accounts for the performance contracting portion of ESCO revenue. Total 2011 ESCO industry revenue in China was estimated to be about 3.5 times the performance contracting portion. [29]

¹⁵ Bertoldi et al. estimates reported in Euros were converted to U.S. Dollars at an exchange rate of \$1.288 per Euro.

be extended to other countries provided that comparable publicly-available data exists for ESCO projects, building characteristics, and company revenue.

6. Conclusion and Limitations

This study provides a preliminary estimate of the remaining investment and savings potential in markets typically served by the U.S. ESCO industry, and details the methodology the authors developed to produce that estimate. The analysis results suggest that the remaining investment potential in facilities typically addressed by the ESCO industry is significant, ranging from ~\$71 to \$133 billion. The authors also found that the U.S. ESCO industry continued to grow at a steady pace in recent years—despite the onset of a major recession that began in 2008—reporting revenues of ~\$5.3 billion in 2011.

It is important to note that estimating the remaining market potential of any industry is an inherently difficult undertaking with key assumptions significantly affecting the accuracy of the results. Our analysis strategy entailed: (1) avoiding an unnecessarily-complex estimation technique; (2) openly communicating our method; and (3) limiting the number of key assumptions used in the analysis. For example, we assumed that—on average—the investment levels (i.e., project installation costs) and savings opportunities of the entire ESCO industry are comparable to the investment and savings levels achieved by ESCOs as reported in the LBNL/NAESCO database of projects for installations occurring from 2003-2012. We also assumed that the buildings already addressed by the industry have no remaining energy efficiency potential—even though we know this is not the case. The population of public and private commercial buildings is based on the most recent version of CBECS, which was released a decade ago. In this case, we are assuming that the existing population of addressable buildings has not changed since 2003. We assumed that ESCOs' core business model is performance contracting and that many commercial and industrial customers do not want to enter into long-term ESPCs. We assumed that ESCOs will generally not pursue retrofit projects in buildings less than 4,645 m² (see Table 11). *For these reasons, we view our estimates of remaining market potential for the ESCO industry as a preliminary estimate that could be refined with better and more recent data.*

Finally, we reported that the U.S. ESCO industry is similar in size to industries in Germany, France and China, but definitions, savings allocation, and revenue reporting practices vary widely across countries. We suggest that our analytical approach could prove useful for other countries who are interested in estimating the current size and remaining investment potential for this emerging industry.

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Figures and Tables:

Figure 1. Flowchart illustrating methodology for estimating 2011 ESCO industry revenue

Table 1. Median projected annual growth rates by ESCO size (2012-2014)

ESCO Market Size	Count	Median Projected Growth Rate
Small (< \$100M in revenue)	32	15%
Medium (\$100M - \$299M)	8	10%
Large (>= \$300M)	5	7%

Figure 2. Flowchart illustrating methodology for estimating remaining potential for markets typically addressed by ESCOs

Table 2. CBECS data query parameters used to compile addressable floor area for market segments (excluding public housing and federal government sector)

Market Segment	Query Parameters		
	Ownership	Building Type	Square Footage
State/Local	State + Local	Office, Public Assembly, Religious Worship, Food Sales, Non-refrigerated Warehouse, Food Service, Lodging–Hotel, Lodging–Motel, Retail Other Than Mall,	$\geq 4,645 \text{ m}^2$

Market Segment	Query Parameters		
		Service, Public Order and Safety	
K-12 Schools	(No selection)	Elementary, High School, Preschool	$\geq 4,645 \text{ m}^2$
University / College	(No selection)	Education– College, Lodging– Dormitory	$\geq 4,645 \text{ m}^2$
Healthcare / Hospital	(No selection)	Outpatient Health Care, Hospital	$\geq 4,645 \text{ m}^2$
Private Commercial¹⁶	Property Management Company, Other Corporation, Religious Organization, Other Non-profit Organization, Individual Owner, Other Non-government Owner	Office, Public Assembly, Religious Worship, Food Sales, Non-refrigerated Warehouse, Food Service, Lodging– Hotel, Lodging-Motel, Retail Other Than Mall, Strip Mall Shopping, Service, Public Order and Safety, Nursing Home, Enclosed Mall	$\geq 4,645 \text{ m}^2$

Table 3. Estimated total floor area of ESCO-addressable buildings by market segment in 2003

Market Segment	CBECS Sample Size	Number of Buildings (Units)	Average Floor Area (m ²) per Building (Unit)	Total 2003 Floor Area (million m ²)	% of Total 2003 Floor Area
Private Commercial	331	48,174	14,243.4	686.2	33.6%
K-12 Schools	236	48,738	9,747.0	475.1	23.3%
Federal	N/A	N/A	N/A	231.8	11.3%
State/Local	113	18,542	11,655.9	216.1	10.6%
Health and Hospital	254	11,504	18,121.7	208.5	10.2%
Universities/Colleges	70	11,236	11,192.4	125.8	6.2%
Public Housing	N/A	1,164,972	84.3	98.2	4.8%
Total				2,041.7	100.0%

¹⁶ The CBECS query tool does not delineate owner-occupied versus leased buildings, so we used the source microdata to identify the population of commercial buildings greater than or equal to 4,645 m² and owner-occupied.

Table 4. Median ESCO market penetration estimates: % of total market floor area for each market segment that has been addressed by performance-based contracts since 2003

Market Segment	U.S. Census Region				
	Northeast	Midwest	South	West	U.S.
K-12 Schools	45%	40%	42%	30%	42%
State / Local	39%	30%	30%	45%	30%
Federal	27%	28%	25%	27%	28%
Universities/Colleges	25%	25%	23%	30%	25%
Public Housing	20%	15%	18%	18%	18%
Health/Hospitals	10%	10%	15%	15%	10%
Private Commercial	10%	6%	8%	9%	9%

Table 5. Estimated total floor area (million m²) of buildings that have received performance-contracting retrofit projects since 2003

Market Segment	Floor Area Retrofitted: 2003-2012 (million m ²)	% of Total Floor Area Retrofitted: 2003-2012
K-12 Schools	199.5	43.3%
Federal	64.9	14.1%
State/Local	64.8	14.1%
Private Commercial	61.8	13.4%
Universities/Colleges	31.4	6.8%
Health / Hospitals	20.8	4.5%
Public Housing	17.7	3.8%
Total	460.9	100.0%

Figure 3. Range of K-12 schools project investment levels (2003-2012)¹⁷

Figure 4. Range of federal project investment levels (2003-2012)¹⁸

¹⁷ The maximum investment level for K-12 schools projects was \$849.73 m². Six K-12 projects had investment levels greater than \$269 m²; the average investment level for those six was \$525.10/m².

¹⁸ The maximum investment level for federal projects was \$1,262.43. Forty-two federal projects had investment levels greater than \$269 m²; the average for those forty-two projects was \$436.64 m².

Table 6. Median (“low”) and average (“high”) per-project investment and savings levels by market segment (2003-2012)¹⁹

Market Segment	Median Project Installation Cost (\$/m²)	Average Project Installation Cost (\$/m²)	Median Project Blended Energy Savings (MMBtu/m²)	Average Project Blended Energy Savings (MMBtu/m²)
Federal Government	\$29.28 (n=135)	\$75.99 (n=135)	0.16 (n=96)	0.41 (n=96)
State/Local Government	\$70.18 (n=231)	\$107.53 (n=231)	0.26 (n=185)	0.37 (n=185)
K-12 Schools	\$57.37 (n=456)	\$106.56 (n=456)	0.15 (n=375)	0.22 (n=375)
Universities/Colleges	\$60.71 (n=157)	\$104.09 (n=157)	0.20 (n=117)	0.31 (n=117)
Health/Hospital	\$80.19 (n=72)	\$136.70 (n=72)	0.45 (n=49)	0.53 (n=49)
Public Housing	\$58.56 (n=31)	\$70.50 (n=31)	0.18 (n=24)	0.24 (n=24)
Commercial/Industrial	\$23.03 (n=43)	\$53.71 (n=43)	0.20 (n=34)	0.30 (n=135)

Source: LBNL/NAESCO database of projects (see Larsen et al. [2]).

¹⁹ For this report we excluded the industrial sector because ESCO activity in the industrial sector is extremely low (Larsen et al 2012) and data on investment cost/square foot for ESCO projects in industrial facilities in the LBNL/NAESCO database of projects was too limited to provide valid results.

Figure 5. LBNL estimates of reported and projected ESCO industry revenues: 1990-2014²⁰

Table 7. 2011 U.S. ESCO industry revenue by market segment

Market Sector	Share of Total Revenue	2011 Revenue (\$ million)
State/Local	24.0%	\$1,234
Federal	21.4%	\$1,102
K-12 Schools	19.4%	\$995
University/College	13.7%	\$702
Commercial/Industrial (C&I)	8.1%	\$419
Health/Hospital	5.9%	\$302
Public Housing	4.2%	\$217
Other	3.3%	\$168
SUBTOTAL (n=35)	100.0%	\$5,138
Non-respondents/Delphi process (n=10)	-	\$125
TOTAL		\$5,263

²⁰ This figure contains revenue estimates from four sources as originally described in Stuart et al. [14]. Revenue projections for 2009-2011 and 2012-2014 are from Satchwell et al. [13] and Stuart et al. [14], respectively.

Figure 6. 2011 ESCO industry revenue by business activity

Figure 7. ESCO industry revenue in 2008 (left) and 2011 (right) by technology/project type

Table 8. Estimated remaining U.S. ESCO market potential (billions of 2012 dollars)

Market Segment	Low Estimate	High Estimate
K-12 Schools	\$15.8	\$29.4
Health/Hospital	\$15.0	\$25.6
Private Commercial	\$14.4	\$33.5
State/Local	\$10.6	\$16.3
Public Housing	\$4.7	\$5.7
Universities/Colleges	\$5.7	\$9.8
Federal	\$4.9	\$12.7
Total	\$71.2	\$133.0

Figure 8. Range of estimated existing market penetration (2003-2012) and remaining ESCO market potential by market segment

Table 9. Estimated remaining annual blended energy savings potential (trillion Btu)

Market Segment	Low Estimate	High Estimate
Private Commercial	127.7	188.1
Health/ Hospital	84.8	99.0
K-12 Schools	41.5	59.3
State/Local	39.1	55.4
Federal	26.9	68.3
Public Housing	14.8	19.2
Universities/Colleges	19.3	29.4
Total	354.2	518.7

Table 10. Recent ESCO industry size estimates by selected country

Country	Estimated ESCO Industry Size (\$ million)	Source
China	\$5,500 ²¹	EMCA and ICF [27]
United States	~ \$5,300	Authors
Germany	~\$3,900-\$5,200	Bertoldi et al. [32] ²²
France	~\$4,000 - \$5,000	Duplessis et al. [3]; Bertoldi et al. [32]
Italy	~\$640	Bertoldi et al. [32]
Spain	~\$640	Bertoldi et al. [32]
Switzerland	~\$170-\$300	Marino et al. [10]
Denmark	~\$180-\$190	Bertoldi et al. [32]
Japan	~\$374	Murakoshi [28]
Romania	~\$50	Marino et al. [10]

Table 11. Key assumptions for estimating remaining investment potential in markets typically addressed by ESCOs

Assumption	Units	Source	Comments
Typical project installation cost and annual blended energy savings by market segment	\$2012/m ² ; MMBtu/m ²	LBNL/NAESCO Database	Median and average value of projects completed between 2003-2012; assumes typical costs and savings values will not be fundamentally different from past ten years
Market segment penetration	% or number of buildings	ESCOs and Delphi Process	Percentage of market addressed since 2003.
Population of commercial buildings by market segment--except public housing and federal facilities	m ²	CBECS/DOE [15]	Excluded buildings < 4,645 m ² ; commercial buildings only include owner-occupied facilities.
Population of public housing facilities	m ²	RECS/DOE [16]; CLPHA [19]	Floor area based on 2009 data from EIA RECS [16] and CLPHA [19].
Population of federal buildings	m ²	GSA [17] and CBECS/DOE [15]	Comprises owner-occupied federal facilities greater than 4,645 m ² . GSA [17] was used to determine total floor area. CBECS [15] was used to determine <i>share</i> of federal

²¹ Performance contracting investment only; see footnote 19.

			owner-occupied facilities greater than 4,645 m ² .
Typical floor area of building by market segment	m ²	CBECS/DOE [15]	Used in conversion of number of buildings addressed to percentage of market segment addressed

Abstract:

This study presents a method to estimate the market investment potential for energy-saving performance contracts (ESPC) and annual blended energy savings remaining in buildings typically addressed by U.S. energy service companies (ESCOs). We define ESCOs as companies for whom performance-based contracting is a core business activity. The market potential analysis incorporates market penetration estimates provided by industry experts in late 2012, data on U.S. building stock typically addressed by ESCOs, and typical project investment costs from a database of 4,000+ projects. ESCO industry revenue growth significantly outpaced U.S. GDP growth during 2009-2011. We estimate that the remaining investment potential in facilities typically addressed by the ESCO industry ranges from ~\$71 to \$133 billion. Our analysis includes ESCO industry size and growth projections drawing on information from interviews with ESCO executives conducted in late 2012. The U.S. ESCO industry could grow in size from \$6 billion in 2013 to ~\$7.5 billion by 2014, but this growth is contingent on enabling policies. The U.S. ESCO industry is similar in size to the ESCO industries in Germany, France, and China. Our estimation approach could be adapted for other countries with the caveat that ESCO industry definitions and revenue reporting practices vary across countries.