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Current Size and Remaining Market Potential of the U.S. Energy Service Company Industry

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Environmental Energy Technologies Division

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Prepared for the
U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy, Weatherization and Intergovernmental Program

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Acronyms and Abbreviations

ARRA	American Reinvestment and Recovery Act
Btu	British thermal unit
C&I	commercial and industrial (private sector)
CBECS	Commercial Building Energy Consumption Survey
DOE	U.S. Department of Energy
ECM	energy conservation measure
EERE	(DOE Office of) Energy Efficiency and Renewable Energy
EIA	Energy Information Administration
ESC	Energy Services Coalition
ESCO	energy services company
ESPC	energy savings performance contract
FEMP	U.S. Department of Energy Federal Energy Management Program
HUD	U.S. Department of Housing and Urban Development
HVAC	heating, ventilation, air conditioning
IDIQ	DOE's Indefinite Infinite Quantity (IDIQ) Super ESPC contract
LBNL	Lawrence Berkeley National Laboratory
MUSH	Municipal and state governments, universities and colleges, K-12 schools, and healthcare markets
NAESCO	National Association of Energy Service Companies
O&M	operations and maintenance
OE	(DOE Office of) Electricity Delivery and Energy Reliability
OWIP	(DOE Office of) Weatherization and Intergovernmental Programs
PPA	Power Purchase Agreement
QECB	qualified energy conservation bond
UESC	utility energy savings contracts

Executive Summary

In this study, we analyze the market size, growth projections and industry trends in the U.S. ESCO industry, drawing on information from interviews with ESCO executives conducted in late 2012. We define ESCOs as energy service companies for whom performance-based contracting is a key business activity; 45 companies met our definition of an ESCO.[1] We were able to interview 35 of these companies, which represents ~78% response rate. The non-respondent ESCOs were small companies in terms of revenue, representing about 2% of industry revenues.

We also provide a preliminary estimate of remaining ESCO market potential in terms of the one-time project investment potential and annual blended energy savings remaining in U.S. buildings typically addressed by ESCOs, based on market penetration estimates provided by ESCOs and industry experts. Finally, we report the range of impacts of the U.S. economic recession on ESCOs' state and local institutional projects and their use of incentives, tax credits, and financing mechanisms.

Key findings from this study include:

U.S. ESCO Industry and Market Trends

- *The ESCO industry continued to grow at a steady pace--despite the onset of a major recession--reporting revenues of approximately $5.3 billion in 2011, with about 85% of revenues coming from energy efficiency services. We estimate that 2013 revenues will be approximately $6.4 billion.*

ESCO industry revenues have grown steadily since the 1990s, with about 9% annual growth for the three years from 2009-2011. The ESCO industry grew at a much faster pace than U.S. GDP during that time period (see Figure ES-1). The ESCOs' steady growth in recent years may indicate that the primary ESCO business model is somewhat less sensitive to the effects of the economic recession, because performance-based contracting allows customers to implement large energy savings projects with little or no up-front capital investment.[2]

[1] For purposes of estimating revenues and remaining market potential, we define ESCOs as firms that provide energy efficiency-related and other value-added services and for which performance contracting makes up 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. We do 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 project energy savings and/or performance. We also exclude companies that only provide on-site generation or renewable energy systems without also deploying energy efficiency measures.

[2] ESCOs expected that the American Reinvestment and Recovery Act (ARRA) would significantly boost funding for energy efficiency retrofits in the public sector, given that a large share of State Energy Program block grants going toward building retrofits targeted the public and institutional sector, a key market for ESCOs. In Section 2.3, we discuss how the anticipated market expansion from ARRA did not fully meet industry expectations.

About 85% of 2011 ESCO industry revenues were generated by energy efficiency-related services (energy efficiency, O&M contracts, commissioning, and utility program implementation), which represents about a 10% increase in the share of revenue from these services since 2008.

- *The ESCO industry could reach $7.5 billion in annual revenues by 2014 with ESCOs projecting growth rates for the next three years that are comparable to their actual growth rates from 2009-2011.*

We estimate that the ESCO industry, in aggregate, could reach annual revenues of approximately $7.5 billion in 2014 based on short-term projections provided by individual ESCOs. Overall, the ESCO industry projects that revenues will increase at ~12% per year during the next three years (2012 to 2014) (see Figure ES-1). This revenue growth forecast is more conservative than in previous LBNL studies of the ESCO industry (e.g. ESCOs projected growth rates of 25% per year from 2009 to 2011).

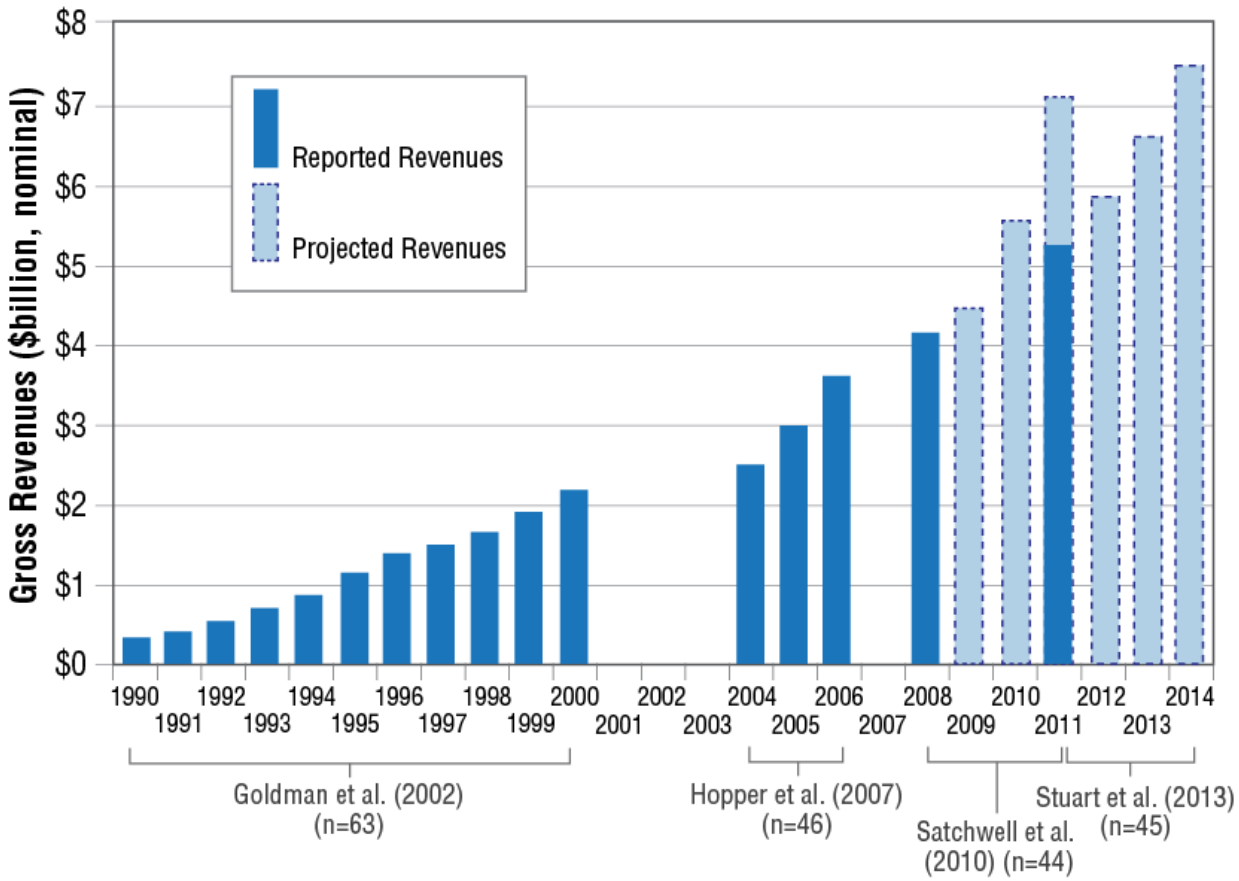

Figure ES- 1. LBNL estimates of reported and projected ESCO industry revenues: 1990-2014

- *Reported revenues for 2011 were lower than the ESCO industry had anticipated.*

Satchwell et al. (2010) reported that ESCOs projected that revenues would exceed $7 billion in 2011, with revenues increasing by about 25% per year between 2009 and 2011 (see Figure ES-1). ESCOs made these projections before the sustained impact of the economic downturn was known. Reported revenues in 2011 were about $5.3 billion.

- *The ESCO industry could more than double or triple in size by the end of the decade.*

We developed three scenarios that project ESCO industry revenues to 2020 using assumptions that extrapolate future revenues based upon actual growth rates reported for various time periods. The ESCO industry could more than double in size from ~$5.3 billion in 2011 to $10.6-$15.3 billion by 2020 (see Figure ES-2).

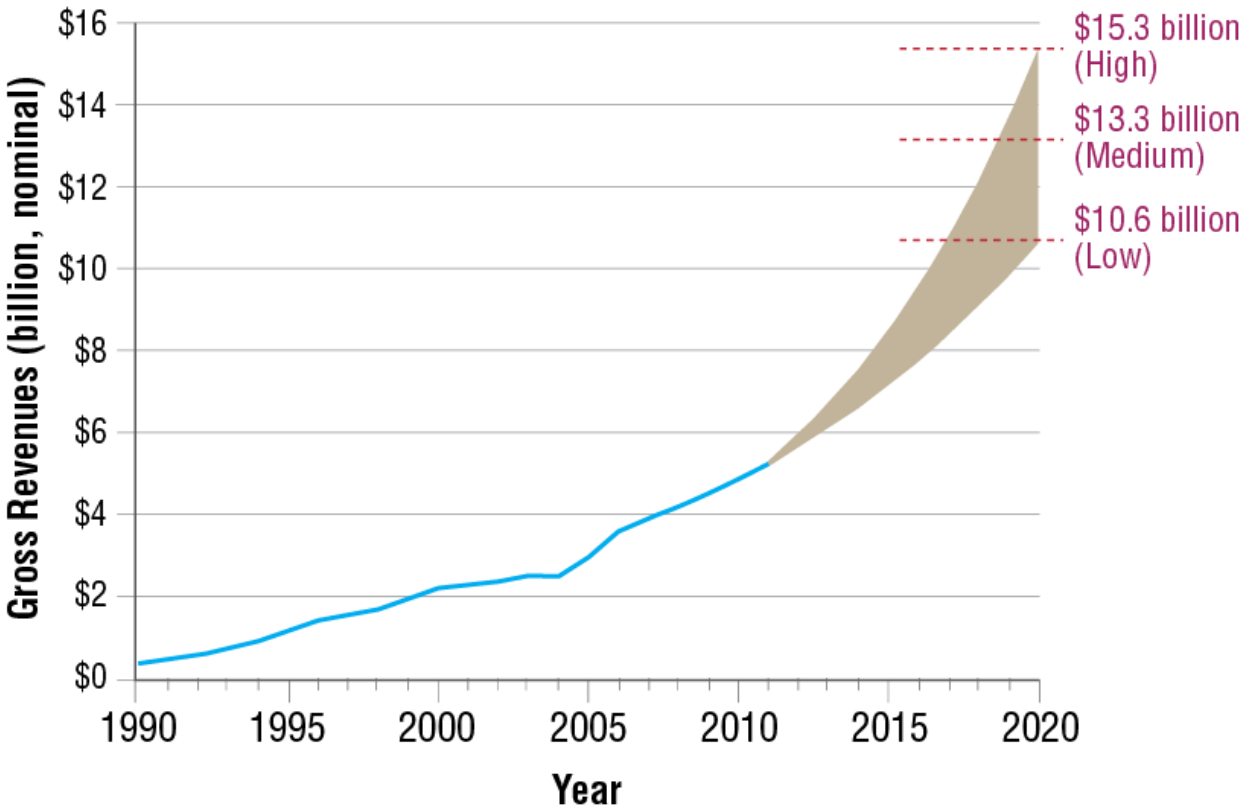

Figure ES- 2. Aggregate industry revenues with long-term projections: 1990-2020

- *Public and institutional markets accounted for about 84% of ESCO industry revenue in 2011—consistent with results reported in our last study.*

Over the past three years, the federal sector share of ESCO revenue grew significantly (15% share in 2008 to 21% in 2011), while the state/local government revenue share remained constant, and the share of revenue from healthcare, K-12 schools and college/universities declined somewhat. The increase in the federal sector revenues may partly be attributed to federal initiatives to achieve energy efficiency and GHG reduction targets and the impact of the American Reinvestment and Recovery Act (ARRA) funding. Barriers to implementing

performance contracts remain high in private sector commercial and industrial facilities and accounted for only 8% of ESCO industry revenues in 2011. The residential market continues to make up a very small portion of industry revenues with a 3% share.

- *ESCOs reported a significant decline in revenue from renewable and other onsite generation projects.*

Satchwell et al. (2011) and Larsen et al. (2012a; 2012b) observed that onsite generation and renewable energy projects became more prevalent in the ESCO industry from 1990-2008. We found that both total and relative share of revenues from onsite energy installations declined between 2008 and 2011. For example, Satchwell et al. (2010) reported that onsite renewable energy projects comprised about 15% of industry revenue in 2008 ($565M with 29 ESCOs responding), whereas we found that onsite renewable energy projects generated less than 6% of industry revenue in 2011 (~$250M with 34 ESCOs reporting). Similarly, we observed a decline in share of revenues from engine/turbine technology from 6% in 2008 ($233 million) to 3% in 2011($130 million). In aggregate, onsite generation and renewable projects generated about 20% of ESCO industry revenue in 2008, but this share had declined to only about 9% of total revenue in 2011.

The reduced contribution of renewables in ESPC projects may be attributable to several factors. First, there has been a proliferation of companies that specialize in renewable generation installations and have developed attractive service offerings (e.g., solar leasing models with no upfront costs). These companies that specialize in onsite renewable electricity generation 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 (DOE 2013a). Lower SREC prices may make implementing solar projects less attractive to some ESCOs as well as end use customers.

Remaining ESCO Market Potential

- *ESCOs estimate that market penetration of performance contracting is highest in the K-12 schools sector and lowest in the C&I and healthcare sectors.*

We asked individual ESCOs to estimate the percentage of facility floor area in each market segment that has received a performance-based retrofit provided by an ESCO since 2003. We calculated the median values provided by ESCOs in each market segment for four U.S. census regions. ESCOs indicated that market penetration is generally highest for K-12 schools across the U.S. (a median value of 42%). ESCOs reported 30% and 28% penetration levels for the state/local and federal government sectors, respectively, from 2003-2012. About 25% of the university and college market has been addressed, and ESCOs estimate 18% penetration in the Public Housing sector. ESCOs report relatively low market penetration levels (<10%) in private commercial sector buildings and health/hospital markets (see Table ES-1).

Table ES- 1. Median ESCO market penetration estimates: % of total market floor area 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%

- *We estimate that the remaining investment potential in facilities typically addressed by the ESCOs industry ranges from ~$71 to $133 billion.*

We developed an estimate of remaining market potential by combining research on buildings typically addressable by ESCOs; floor area estimates for various market segments from several sources [e.g., CBECS (DOE 2003), RECS (2009), HUD (2013) and GSA (2003)]; typical project investment and energy savings from the LBNL/NAESCO project database; and ESCO executives' estimates of market penetration. This preliminary analysis found that there is still a considerable opportunity for ESCO opportunity in all market segments. The private commercial building sector (~14 to $34 billion), K-12 schools ($16 -29 billion), and health and hospital markets ($15-26 billion) have the largest estimated remaining market potential for ESCOs in terms of investment. The remaining market potential is somewhat lower in the federal, state/local and university/college market segments, although ESCOs have a high likelihood of capturing this potential because of a strong proven track record of overcoming market barriers in these markets (see Figure ES-3).

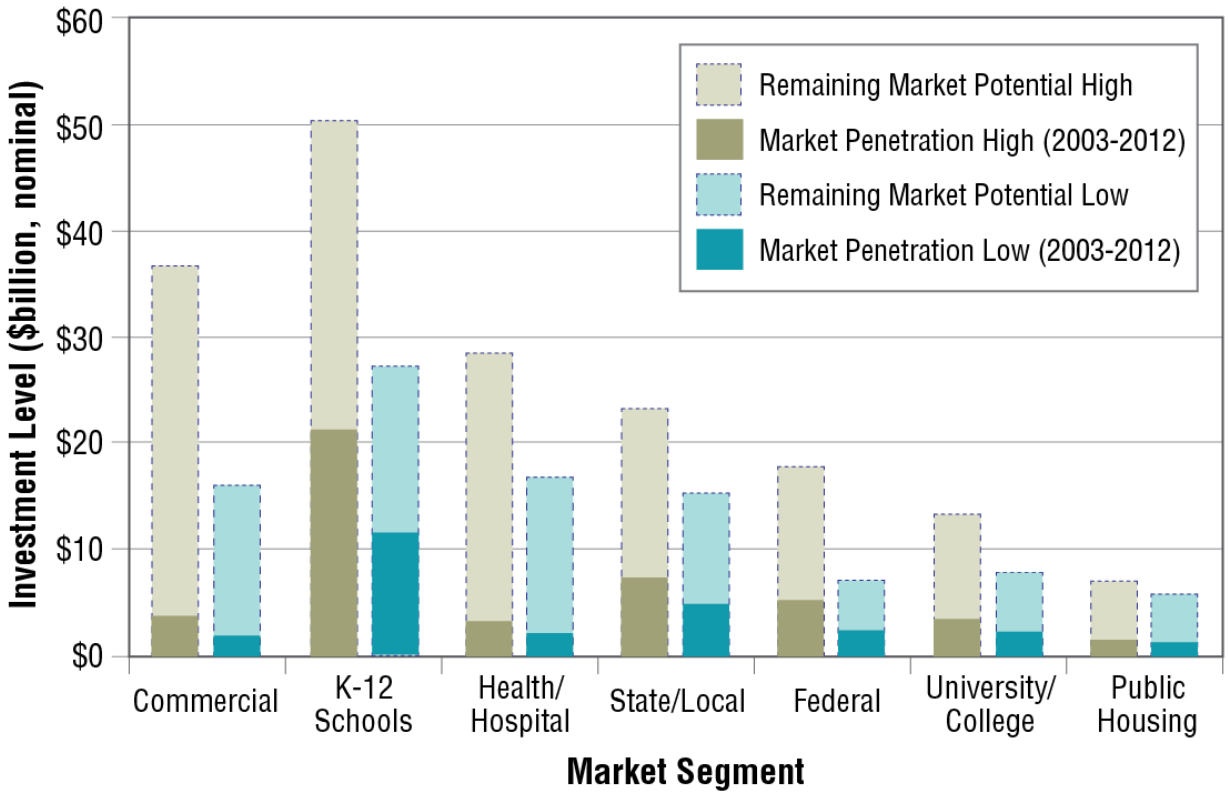

Figure ES- 3. Range of estimated existing ESCO market penetration (2003-2012) and remaining ESCO market potential by customer market segment

U.S. Recession, Incentives, Tax Credits and Financing Vehicles

- *Customers of larger ESCOs tend to use third-party financial advisors more frequently than customers of small-to-medium sized ESCOs.*

Twenty-eight ESCOs reported the share of their projects that involved the use of financial advisors from 2009-2011. Four ESCOs reported that none of their customers during that period used financial advisors. Three large ESCOs reported that a median of 80% of their customers used third party financial advisors, while about 40% of customers working with small or medium-sized ESCOs used advisors.

- *27 of 35 ESCOs reported that some percentage of their projects incorporated utility or public benefit-funded incentives from 2009-2011.*

Twenty-seven ESCOs reported that some portion of their projects used utility customer-funded financial incentives (e.g., rebates, no-cost or subsidized audits, engineering studies or technical assistance). The eighteen small ESCOs among the twenty-seven respondents reported that in aggregate over 80% of their projects used utility incentives. These findings suggest that these types of incentives may be particularly important to the economics of projects typically implemented by smaller ESCOs.

- *ESCOs reported various methods of financing projects including 1) 100% cash; 2) partial cash; 3) term loan; 4) state/local government bond issue; 5) lease; and 6) other financing vehicles.*

ESCOs reported various methods of financing projects and indicated that in aggregate about 40% of their federal projects paid for their projects with 100% cash. About 19% of federal projects involved third party-financed leases, and about 31% of federal projects used other types of financing. K-12 schools most commonly used state or local bond issuances or lease arrangements (62%). State and local government customers used a range of financing vehicles, most commonly tax-exempt municipal leases (see Figure ES-4).

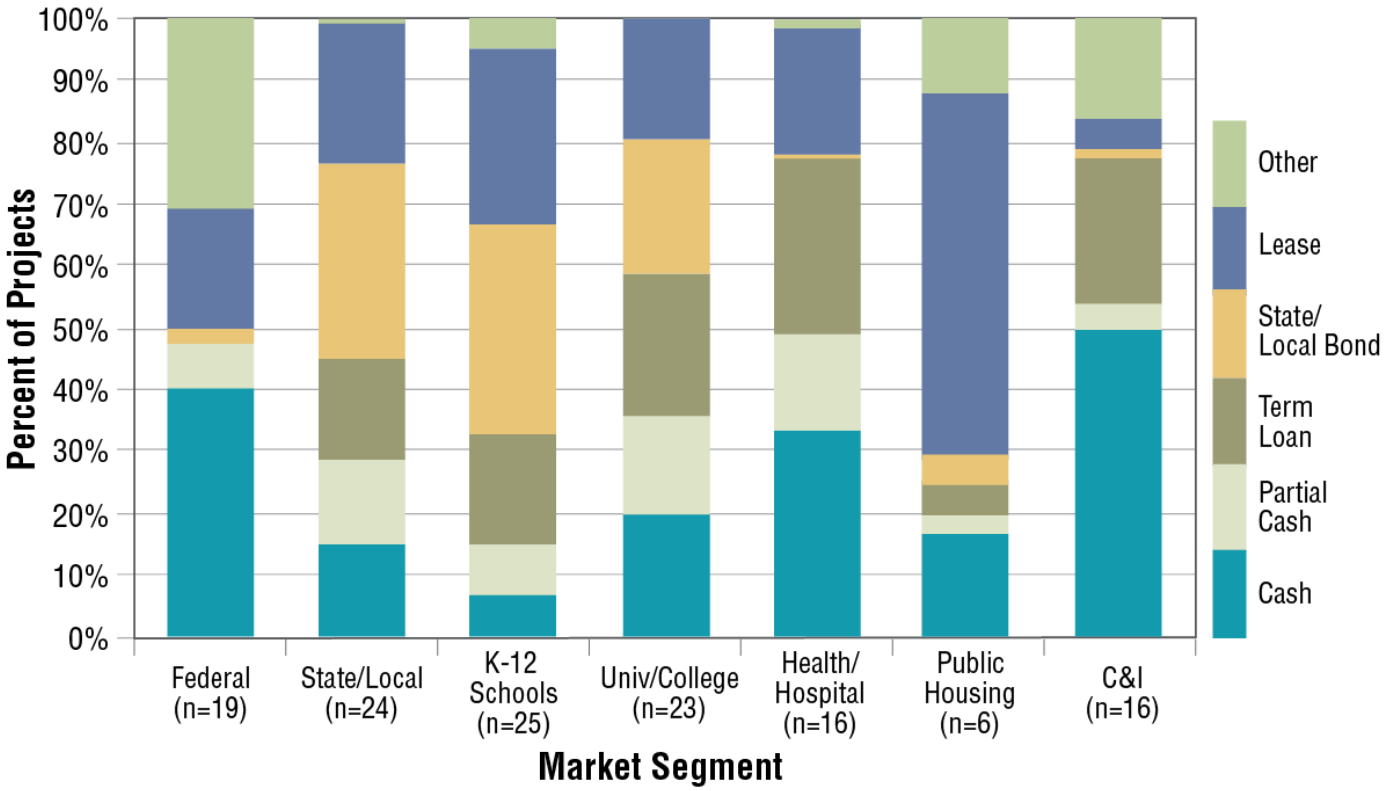

Figure ES- 4. Financing methods used by ESCO customers (2009-2011)

The U.S. ESCO Industry in a Global Context

- *The U.S. ESCO industry is comparable in size to the ESCO industry in Germany, France, and China, although definitions of ESCOs and revenue reporting practices vary across countries.*

Our estimate of U.S. ESCO revenues in 2011 ($5.3 billion) is on par and likely somewhat higher than estimates for the French and German ESCO industry (estimates range from $3.9 to $5 billion) and the Chinese ESCO industry ($4-7 billion in 2012).

1. Introduction

A significant ramp-up in 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, 15 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., 10 years). Six additional states have established statutory or regulatory requirements that utilities acquire "all cost effective" energy efficiency (Barbose et al. 2013). In response to a 2011 presidential memorandum (Obama 2011), the U.S. Department of Energy (DOE) is tasked with implementing $2 billion 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 federal market activity compared to previous years.[3]

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) (Larsen et al. 2012a; Goldman et al. 2005; Hopper et al. 2005).

Larsen et al. (2012b) 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.*[4]

Performance contracting provides a vehicle for implementing energy projects with little or no up-front capital costs, paying back the project installation and financing costs over time out of the energy and maintenance savings. Successfully-implemented ESPCs help customers cover retrofit costs using the dollar savings produced by the installed energy-saving measures over time. For this reason, these types of contracts have become popular vehicles for meeting energy conservation goals and infrastructure modernization.

This study builds on previous Lawrence Berkeley National Laboratory (LBNL) ESCO industry reports that incorporated company interviews (Satchwell et al. 2010; Hopper et al. 2007). We provide updated estimates of ESCO industry and market segment revenues and recent and projected growth trends. We also present additional information on the following topics: 1) a

[3] 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 (FEMP 2013a).

[4] 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 (Soroye and Nilsson 2010; Marino et al. 2010).

preliminary estimate of the remaining ESCO industry potential (expressed in terms of investment opportunity and projections of potential energy savings); 2) self-reported information from ESCOs on project financing and use of financial incentive programs; and 3) perceived impacts on ESCOs and their customers arising from the recent U.S. economic downturn.

This report is intended for federal, state and local policymakers, ESCO industry executives, other energy efficiency service providers, and end users in the institutional and commercial market. The report is organized as follows. Section 2 provides an estimate of ESCO market size, growth, and industry characteristics. Section 3 discusses findings on recent and emerging ESCO project financing trends. Section 4 provides an estimate of the remaining ESCO market potential and Section 5 compares the size of the U.S. ESCO industry to other counties and Section 6 provides conclusions based on the analyses contained in the report.

2. U.S. ESCO Industry Revenue and Market Characteristics

In this section, we discuss data sources and methods and present estimates of 2011 ESCO industry revenues, projected growth trends, and market characteristics.[5]

In estimating the size of the ESCO industry, we include only those companies that meet our definition of an ESCO: ESCOs are firms for which performance contracting is a core part of their energy-efficiency services business. We do 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 exclude companies that only provide on-site generation or renewable energy systems without also deploying energy efficiency measures. These companies play important roles in the broader market for energy efficiency, clean energy, and retail energy services, but they are not included in our assessment of the U.S. ESCO industry.

2.1 Data Sources and Approach

We collected information from a number of sources including:

- Interviews with ESCOs;
- Publicly-available information on ESCO financial performance;
- The LBNL/NAESCO database of projects; and
- A Delphi[6] process with industry experts.

The primary source of information for this report came from discussions conducted with U.S. ESCOs in the summer and fall of 2012. ESCOs 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 excludes retail commodity sales or projects built to supply power to wholesale markets. ESCOs were also asked to provide information about project financing vehicles and an estimate of market saturation for their service area.

We developed a comprehensive list of firms that either self-identified as ESCOs on company web sites, are NAESCO member organizations, or were included on qualified lists of energy service providers. 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:

[5] Some material in this section draws upon previous LBNL studies that analyzed ESCO industry and market trends (Larsen et al. 2012a, Larsen et al. 2012b, Satchwell et al. 2010, Hopper et al. 2007, Goldman et al. 2005).

[6] 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 (e.g., see Hopper et al. 2007 and Linstone and Turoff 1975).

- NAESCO-accredited ESCOs;
- 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.

We identified an initial list of 144 companies that provide energy efficiency services, possibly including performance contracting as part of their business. Next, we conducted additional research, consulted with NAESCO staff, conducted a Delphi process with several industry experts, and directly contacted companies to narrow down the list to only those companies that appeared likely to meet our specific definition of an ESCO. Through the interview and Delphi process, we identified 45 ESCOs that met our criteria and were actively working within the United States.[7] We were able to interview 35 of the 45 companies; thus our response rate was ~78%, with the remainder of the information on non-responding companies coming from the Delphi process.

All of the non-respondent ESCOs are 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.

First, we estimated total 2011 ESCO industry size from energy services by aggregating revenues reported by the 35 ESCOs who participated in our interview and the 10 ESCOs that did not respond to our requests. We estimated ESCO revenues from the latter group of companies through a Delphi approach with industry experts. We compared the 2011 estimated revenues with revenue reported by ESCOs as part of the Satchwell et al. (2010) study and to other recent public information (e.g., company reports, U.S. Securities and Exchange Commission 10-K filings). We aggregated revenue estimates for individual companies to arrive at our estimate of ESCO industry revenues in 2011 (see Figure 1 for a flowchart of data sources and methods for estimating ESCO industry size). For ESCOs that are part of a larger organization, the revenues included in this report are derived exclusively from the business unit providing ESCO-related services.

[7] Several of the ESCOs included in Satchwell et al. (2010) were excluded from the current industry estimate either because they indicated they did not self-identify as an ESCO or were determined not to be an ESCO in the Delphi process.

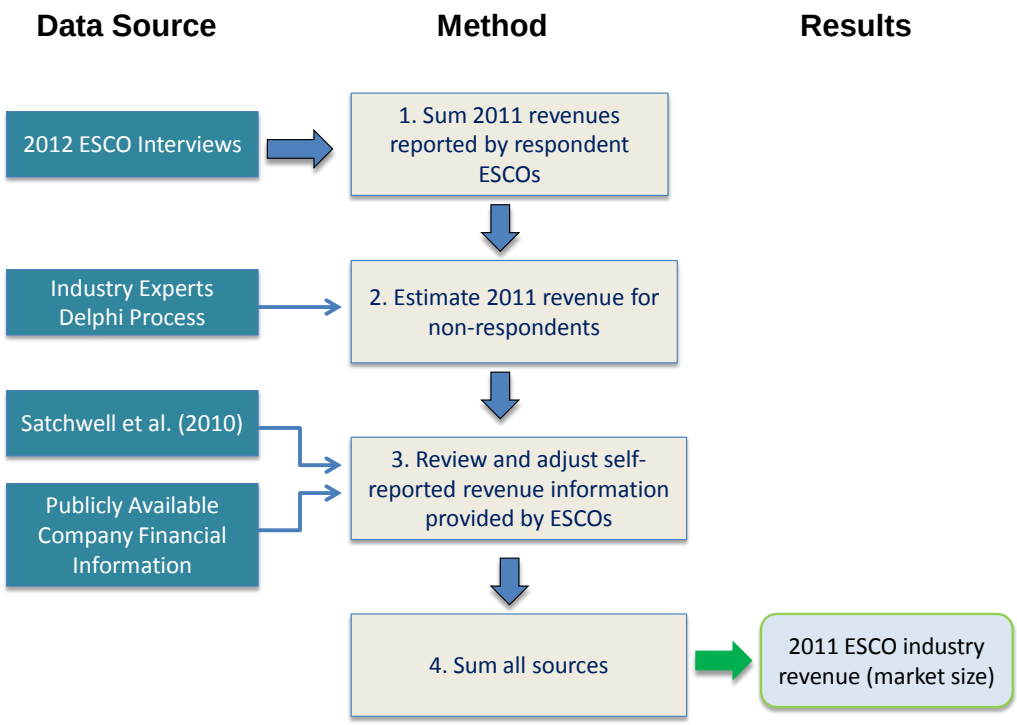

Figure 1. Flowchart illustrating methodology for estimating 2011 ESCO industry revenue

Next, 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 (< $100M in 2011 revenue), medium ($100M-$299M) and large companies (>=$300M). We applied these median growth rates to non-respondent ESCO revenues of the corresponding sizes to determine the 2012-2014 revenue projections. On average, small ESCOs projected a 15% annual growth rate for 2012-2014 (see Table 1).

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%

2.2 ESCO Industry Revenues and Growth Trends

We estimate that aggregate ESCO industry revenue was about $5.3 billion in 2011; energy efficiency projects account for about 85% of revenue. In comparison, Satchwell et al. (2010) 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 2).

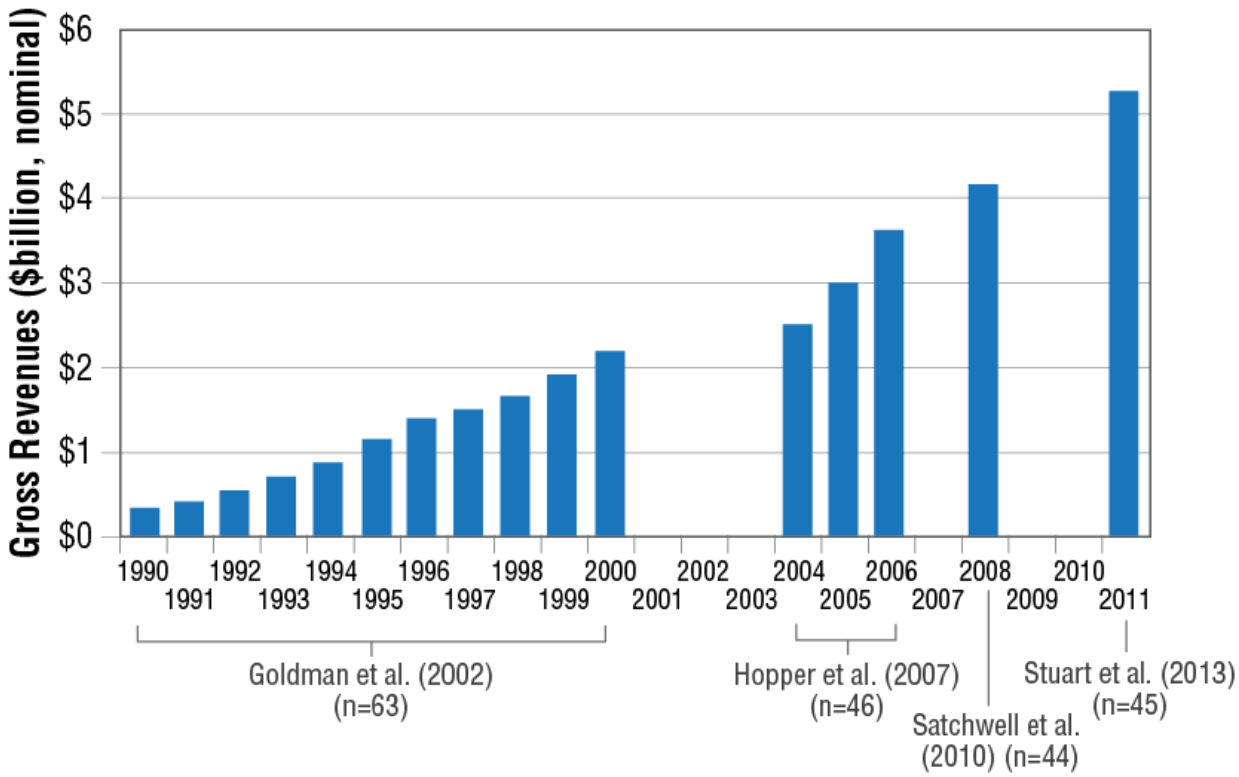

Figure 2. Aggregate ESCO industry revenue from 1990 to 2011[8]

2.3 Short-term Projected Growth

As discussed earlier, we developed an aggregate estimate of projected U.S. ESCO industry revenues for 2012-2014 by applying each ESCO's growth projections to their 2011 revenues. We found that the U.S. ESCO industry anticipates annual revenues of approximately $7.5 billion by 2014, which represents an average annual growth rate of ~12% over the three year time horizon (see Figure 3).

[8] This graph shows revenue for only the years for which we have actual ESCO-reported data.

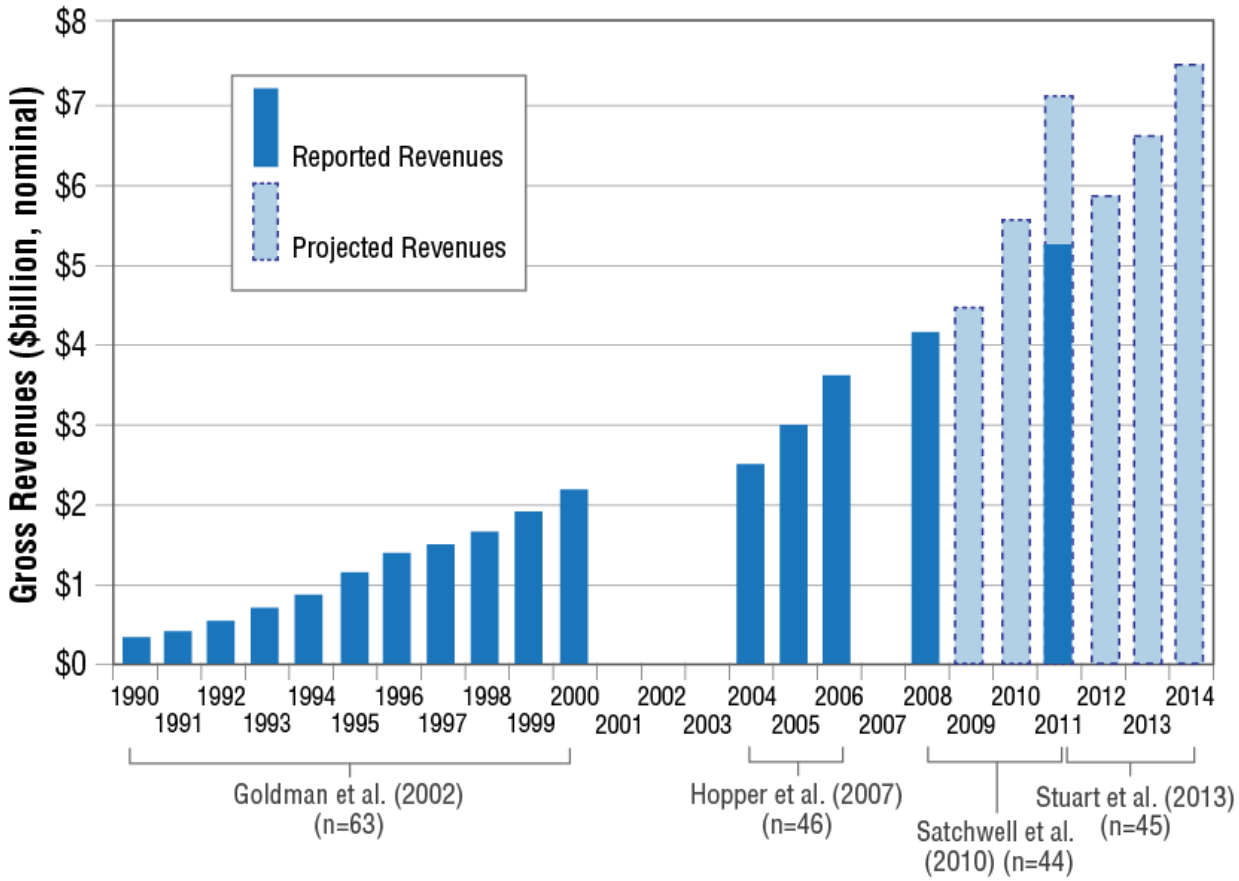

Figure 3. LBNL estimates of reported and projected ESCO industry revenues: 1990-2014[9]

We also compared revenue reported in this study with ESCO industry projections of future revenues from a previous LBNL study. Satchwell et al. (2010) reported that ESCOs anticipated an annual growth rate of ~25% from 2009 through 2011. ESCOs' projections were in part fueled by expectations that the Clinton Climate Initiative's (CCI) Energy Efficiency Building Retrofit Program (EEBRP)[10] would expand ESCO opportunities substantially in the private commercial market segment. The initiative contributed to a number of U.S. projects, most notably a substantial retrofit of the Empire State Building. However, the anticipated expansion of ESCO activity in the commercial sector market did not fully meet industry expectations. ESCOs also expected that the American Reinvestment and Recovery Act (ARRA) would boost funding for energy efficiency retrofits in the public sector, given that half of the $1.5 billion in State Energy Program block grants going toward building retrofits targeted the public and institutional sector, a key market for ESCOs (Goldman et al. 2011). Had this growth projection materialized, industry revenues might have reached ~$7.3 billion in 2011. Reported revenues in 2011 (~$5.3 billion) were about $2 billion lower than what ESCOs had projected in 2009 (see Figure 3). One

[9] This figure contains revenue estimates from four sources (Goldman et al. 2002; Hopper et al. 2007; Satchwell et al. 2010; and Stuart et al. 2013). Revenue projections for 2009-2011 and 2012-2014 are from Satchwell et al. (2010) and Stuart et al. (2013), respectively.

[10] The EEBRP (CCI 2013) was launched in 2007 as a large-scale collaboration between ESCOs, building owners, financiers and technology providers to expand the market for performance contracting in non-residential buildings.

possible factor explaining why projections were higher than realized revenues may be unanticipated cutbacks in the number and scope of projects. In the interviews for this study, ESCOs reported that about 25% of planned state and local projects were scaled back and 19% were cancelled altogether between 2009 and 2011 as a result of the financial crisis (see section 3 for a more detailed discussion).

It is important to recognize that ESCO industry revenues still grew at a significant rate between 2009 and 2011 (approximately 9% annually in nominal terms), much faster than GDP, which grew an average of 1.9% annually during that same period (BEA 2013).

Previous industry studies found that ESCOs tended to be overly optimistic about their annual growth prospects. For example, Satchwell et al. (2010) and Hopper et al. (2007) reported that the U.S. ESCO industry in aggregate anticipated ~25% and 18% annual growth rates, respectively.

Based on ESCOs' projections of ~12% annual growth for 2012-2014, we estimate that revenues in 2013 will be about $6.4 billion (see Figure 4). Interestingly, ESCOs' current 3-year growth projection is considerably more conservative than previous projections. Several factors may account for ESCOs' reduced projections. There are currently no expectations for new stimulus programs at the federal level aimed at accelerating energy efficiency investments. Programs funded under the ARRA are also coming to an end, thereby generally reducing the amount of federal funds available to support energy efficiency projects in the public and institutional sector. Moreover, the ESCOs' relatively conservative growth projections reflect the belief of many economists that the economic recovery is still dragging; a Congressional Budget Office (2012) study underscored this economic lag reporting that the U.S. economy is experiencing a slower recovery than would normally be expected for several reasons including continued credit restraints imposed by lenders.

2.4 Projected Growth in ESCO revenues to 2020

We developed three alternative scenarios to project long-term ESCO industry growth to 2020:

- Low case: industry growth rates extrapolated to 2020 based on actual 2008-2011 industry growth rates (8.3% compounded annually);
- High case: industry growth rates extrapolated to 2020 based on ESCOs projected growth rates for 2012-2014 (12.6% compounded annually); and,
- Medium case: industry growth rates extrapolated to 2020 based on an LBNL approach that adjusts ESCO industry growth rates based on observed differences between actual historic and projected growth rates (see Appendix A).

Under these three scenarios, we anticipate that the ESCO industry revenues will range between $10.6 and $15.3 billion by 2020, more than double 2011 industry revenues (see Figure 4 and Technical Appendix for more information).

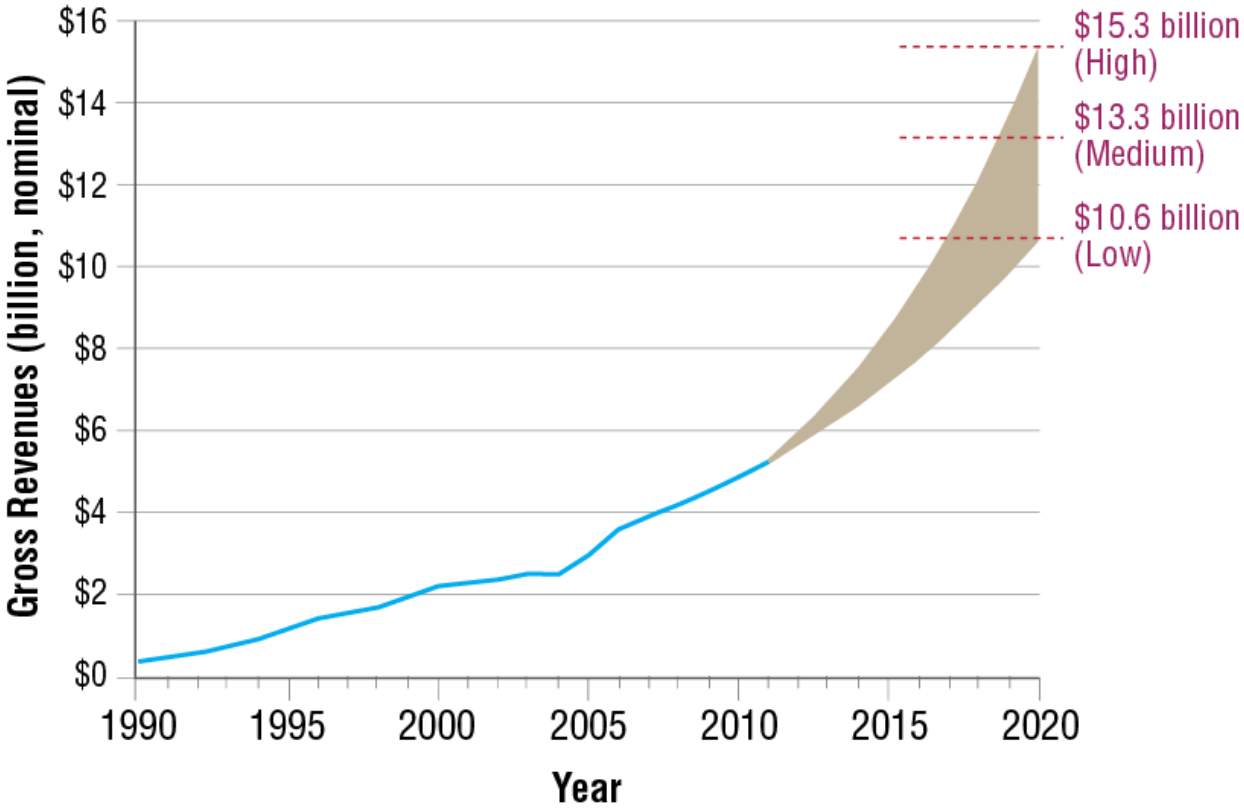

Figure 4. Aggregate industry revenues with long-term projections to 2020

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

Opening up 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 to customers.

G**reater penetration in existing market sectors.** The emergence of commercial (PACE)[11] programs and on-bill repayment programs[12] may lead to new opportunities for ESCOs (including

[11] 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.

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 (a2energy, 2013). 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 driver for ESCOs 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 roofs). 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. Enabling policies have played an important role in the development and maturation of the ESCO industry (e.g., enabling 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 in large urban areas, 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.

2.5 Revenue by Customer Market Segment

ESCOs reported their 2011 revenues by customer market segment, which are summarized in Table 2 below. Key findings are as follows:

- 84% of ESCO revenues in 2011 came from the public and institutional sector, which includes the federal government (see Figure 5). Historically, the bulk of ESCO revenue has come from the "MUSH" and federal markets. 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 share of revenue from public and institutional customers is generally consistent with previous LBNL studies of the ESCO industry.
- The "MUSH" markets, which are comprised of state and local government, universities/colleges, K-12 schools, and healthcare facilities, represented about 64% of industry revenue in 2011. In comparison, Hopper et al. (2007) and Satchwell et al. (2010) reported MUSH revenues of 58% (2006) and 69% (2008), respectively.
- State and local government, federal government, and K-12 schools projects were the three largest sources of revenue for ESCOs, accounting for 24%, 21% and 19% shares respectively.

[12] 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.

Table 2. 2011 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
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**

The state/local government market share of revenue remained relatively constant between 2008 and 2011 (23% vs. 24%), while the share of revenue from K-12 schools declined slightly from 22% to 19%, and the share of revenue from university/college projects declined slightly from 16% to under 14% (see Figure 5). The share of revenue from the federal sector increased from 15% in 2008 to 21% in 2011 (see Figure 5). Hopper et al. (2007) reported that federal sector market share of ESCO revenues was 22%--nearly the same as the 21.4% federal share reported for 2011. The 15% federal share in 2008 appears to be a temporary anomaly as implied by Satchwell et al. (2010). The 2008 decrease may have been a remnant of rules issued in 2007 under the renewed DOE Indefinite Delivery-Indefinite Quantity (IDIQ)[13] contract that may have disallowed some planned projects. [14] The increase in share of federal projects in 2011 may be attributed in part to the second IDIQ competitive solicitation, which announced awardees at the end of 2009, and put in place a hard deadline for project contract awards, so many project contracts were pushed through before the late 2010 deadline.

[13] IDIQ contracts are "blanket" contracts issued to multiple ESCOs by the DOE and Army Corps of Engineers. They streamline procurement of ESPC projects by placing them under a single standardized contract (FEMP 2013b).
[14] The 2007 ESPC IDIQ Continuation Plan required proposals to reach kickoff stage prior to April 1, 2008; projects not meeting that deadline would not be authorized to proceed under the then current DOE ESPC IDIQ contract (DOE 2007).

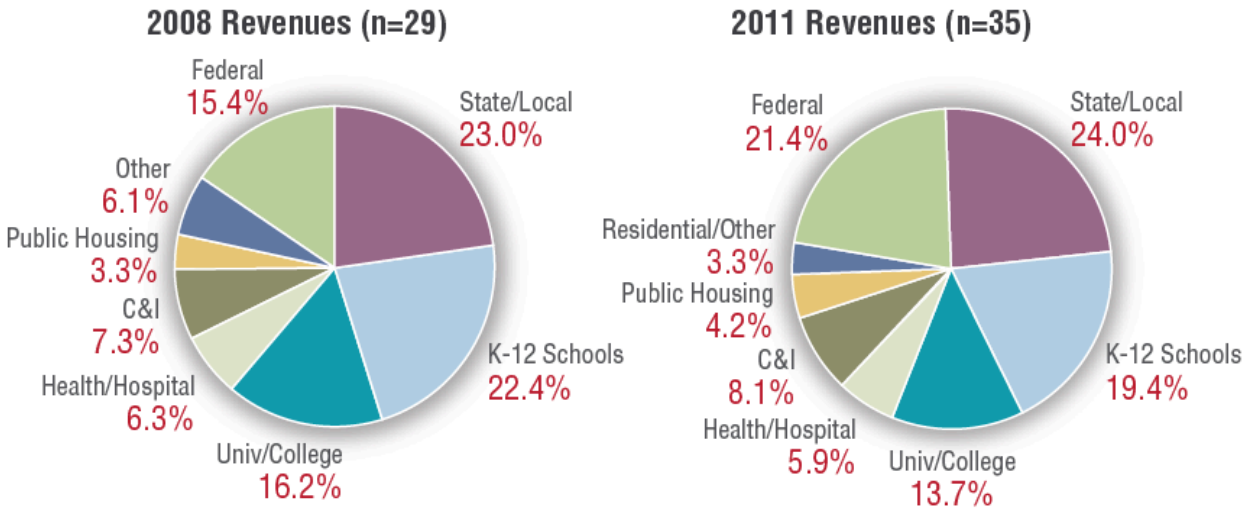

Figure 5. 2008 (left) and 2011 (right) ESCO industry revenues by market segment

Barriers to implementing comprehensive energy projects in private commercial facilities remain high (IEA 2007) and private sector projects accounted for only 8% of ESCO industry revenues in 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 private sector customers--reported that most of their projects were with publicly-held companies. These companies typically prefer to pay cash for energy efficiency projects, rather than financing them. This ESCO reported that its private sector customers were only interested in pursuing projects with extremely short payback times (1-2 years).

2.6 Type of ESCO 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 market shares of 69% and 70% in 2008 and 2006, respectively (Satchwell et al, 2010; Hopper et al. 2007). 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%).[15]

[15] 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.

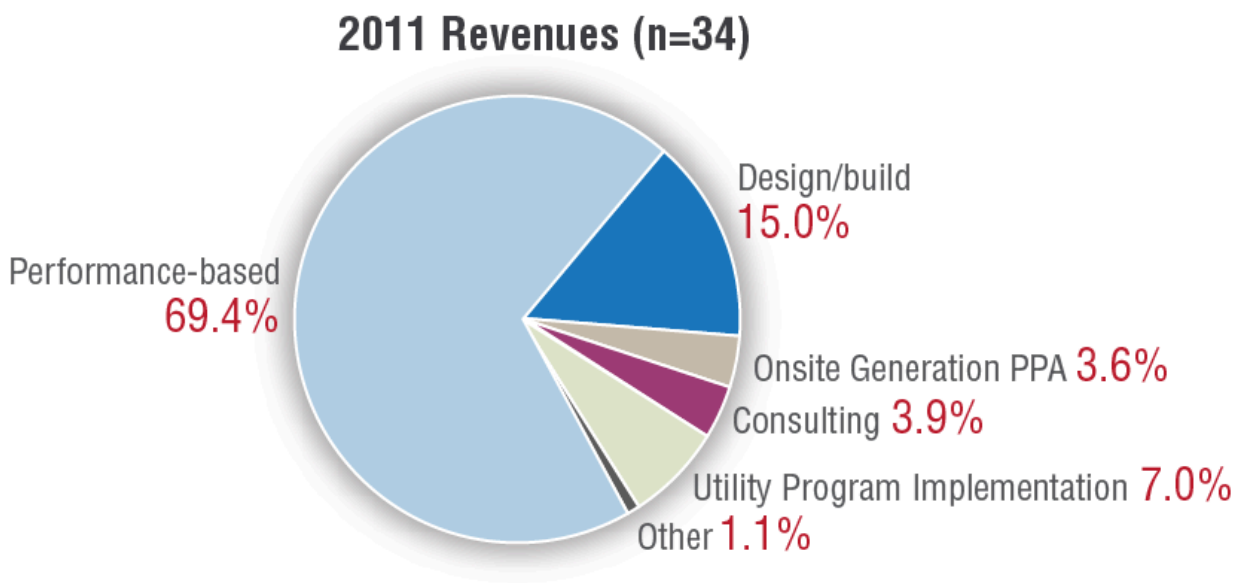

Figure 6. 2011 ESCO industry revenue by business activity

2.7 Project Characteristics – Technology and Project Type

We also asked ESCOs to report revenues by technology/project type. Not surprisingly, energy efficiency comprised nearly three-quarters (about $3.3 billion) of 2011 ESCO industry revenue. Among the remaining categories, onsite generation technologies (i.e., renewable and engine/turbine) accounted for the largest portion (about 8.7% or ~$400 million) of 2011 revenue. Operations and maintenance (O&M) contracts (4.8%), utility program implementation (3.4%), consulting (3.2%), and commissioning (3.1%) generated a relatively small share of industry revenue (see Figure 7).

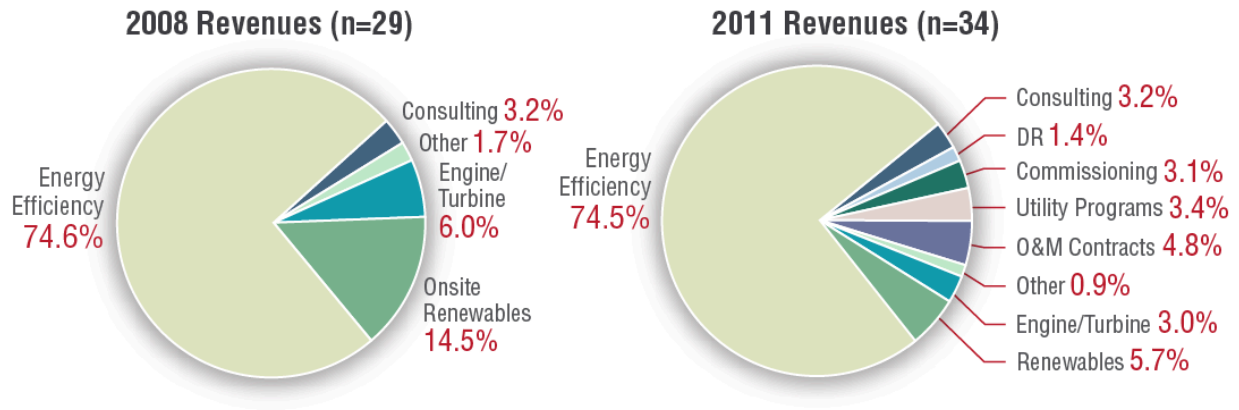

Figure 7. ESCO industry revenue in 2008 (left) and 2011 (right) by technology/project type

Onsite generation is 3.6% of business activity (Figure 6) because that revenue is specifically attributed to power purchase agreements (PPA). However for the share of revenue by technology

or project type, renewable technologies (5.7%), includes revenue from PPAs as well as other types of contracts (see Figure 7).

ESCO revenues from renewable and onsite generation declined in 2011

Satchwell et al. (2010) and Larsen et al. (2012a; 2012b) observed that onsite generation projects became more prevalent in the ESCO industry from 1990-2008.[16] However, in our 2012 interviews with ESCOs, they reported that that both total and relative share of revenues from onsite energy installations declined between 2008 and 2011. Satchwell et al. (2010) reported that onsite renewable energy projects comprised about 15% of industry revenue in 2008 (~$565 million with 29 ESCOs responding), 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 decline in share of revenues from engine/turbine technology from 6% in 2008 ($233 million) to 3% in 2011 ($130 million).

Up until 2008, both renewable and other onsite generation in ESCO performance-based contracts appeared to be a growing share of ESCO project measures (Satchwell et al. 2011; Larsen et al. 2012a; Larsen et al. 2012b). Despite the fact that the Department of Energy's new IDIQ ESPC contract emphasizes the inclusion of renewable energy opportunities (FEMP 2013b), it appears this trend is not continuing. From 2008 to 2011, we observed that some ESCOs increased renewable installations. However, a number of medium and large ESCOs reported lower revenue (and in some cases none at all) from these types of projects in 2011.

During this period, 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 (GTM Research 2012). 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 renewable generation installations and have developed attractive service offerings (e.g., solar leasing models with no upfront costs). These companies that specialize in onsite renewable electricity generation 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 (DOE 2013a). 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

[16] 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%).

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.

Energy efficiency share increased in 2011

In 2011, 85% of 2011 ESCO industry revenues were attributed to energy efficiency-related services (energy efficiency, O&M contracts, commissioning, utility program implementation) representing a ~10% increase in the share of revenue from these services between 2008 and 2011.[17]

2.8 Industry Consolidation and New Entrants

Hopper et al. (2007) reported that eight companies with revenues over $100 million represented 79% of industry activity in 2006. Satchwell at al. (2010) provided examples of ESCO industry consolidation between 2006 and 2008, reporting that twelve companies had revenues over $100 million and together accounted for 88% of industry activity in 2008. We found that 13 ESCOs reported revenues over $100 million for 2011, which represents about 85% of industry activity. This suggests that the market share of medium-to-large ESCOs (i.e., companies with revenues that exceed $100 million per year) have remained relatively stable between 2008 and 2011.

We found evidence from publicly-available documents that larger ESCOs are continuing to acquire smaller ESCOs and other energy service providers (see examples below). At the same time, several new companies began operating as ESCOs within the last year.

Examples of mergers and acquisitions:

- Eaton acquired EMC Engineers in 2010 (Eaton 2010).
- Ameresco acquired three companies in 2011: 1) Applied Energy Group, Inc.; 2) APS Energy Services Company, Inc. (renamed Ameresco Southwest); and 3) Energy and Power Solutions, Inc. (Ameresco 2011).

We found some evidence that ESCOs are acquiring companies and additional capabilities to provide services such as supply procurement, utility bill review and payments, consulting to utilities, and most recently, physical needs assessments.[18]

[17] Satchwell et al. (2010) reported that 74.6% of 2008 industry revenue came from energy efficiency activities. In this study, however, we added several new categories that were not included in the Satchwell et al. (2010) study: (1) demand response (DR); (2) commissioning; (3) utility program implementation; and (4) long-term O&M contracts. It is likely that ESCOs included commissioning, O&M contracts, and utility program implementation in the energy efficiency category, and DR under the "Other" category. Therefore, we combined commissioning, O&M, and utility program revenues with energy efficiency revenues--to make a more appropriate comparison with the energy efficiency category in 2008.

[18] An ESCO industry expert told us that for at least one ESCO, conducting physical needs assessments helped influence some customers to undertake a project, or increase the scope of the project.

New entrants to performance contracting

We also discovered that three energy efficiency service providers began providing performance contracting and operating as ESCOs, per our definition, in late 2011 or during 2012. We were unable to include these companies in our analysis, because they did not have complete revenue information for 2011, but we expect to include them in future studies.

New products

As discussed in section 2.6, there are significant barriers to the use of capital investment and financing for energy efficiency in the private commercial sector. Insurance companies have recently introduced new warranty programs for energy efficiency projects designed to support energy efficiency market growth by insuring and mitigating the performance risks of energy-saving projects (Energi 2012). While it is too early to report any results, such products may make the debt instruments associated with financing of energy efficiency projects more attractive to institutional investors, expanding the availability of capital. These products may also encourage additional companies to enter the performance-based contracting market in the future.
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3. U.S. Recession, Incentives, Tax Credits, and Financing Vehicles

There has been interest in how the U.S. financial downturn affected energy efficiency projects (either directly or indirectly). Furthermore, state and local energy offices along with the U.S. Department of Energy have been exploring opportunities to bridge gaps in the availability of attractive financing tools, such as U.S. Treasury-subsidized Qualified Energy Conservation Bonds (QECBs) to encourage the uptake of additional energy efficiency projects (Zimring 2012). For these reasons, we asked ESCOs to respond to a number of questions related to the U.S. economic downturn, the use of incentives and tax credits, and the type of financing typically used in different market segments.

3.1 Impact of Financial Crisis and/or Debt Policy on State and Local projects

We asked ESCOs that serve customers in the state and local government market to estimate the percent of these projects that have been affected by (1) the U.S. financial crisis or (2) related debt restriction regulations imposed by state and local governments. Twenty-two ESCOs reported that nearly half of their state and local projects implemented from 2009-2011 were not affected by the U.S. financial crisis or related regulations (see Figure 8). ESCOs indicated that about a quarter of the projects were scaled back, but not cancelled, while about 19% of state and local government projects were cancelled altogether.[19] ESCOs reported that ~10% of projects were scaled up.

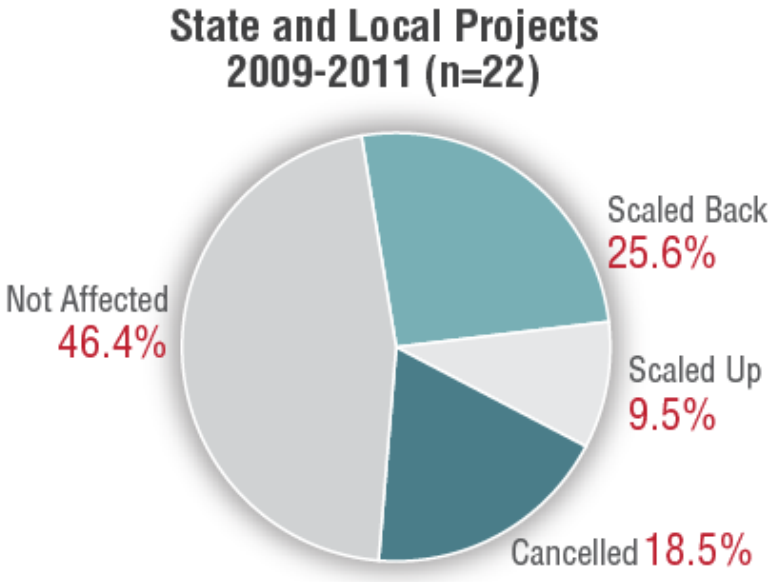

Figure 8. Percentage of state and local government projects affected by either the financial crisis or debt policy from 2009-2011

[19] It is a normal part of business for some share of ESCO projects to not move forward for a number of reasons. However, ESCOs were specifically asked to report cancellations that were specifically related to the financial crisis. It is possible that project cancellation rates may have been higher than normal due to the severity of the recession, and this may have been one factor explaining why ESCO 2011 revenues fell short of ESCOs' projections.

Third-party Financial Advisors

We also asked ESCOs about the use of financial advisors by customers and various types of taxpayer-supported (or utility customer-supported) funds and financial incentives for their projects. We separate the responses by small (<$100M revenue), medium ($100M-$299M revenue) and large ESCOs (>=$300M) and report the median for each category of ESCOs.[20]

Twenty-eight ESCOs reported the share of their projects that involved the use of financial advisors from 2009-2011. Four ESCOs reported that none of their customers during that period used financial advisors. Three large ESCOs reported that a median of 80% of their customers used third party financial advisors, while about 40% of customers working with small or medium-sized ESCOs used advisors (see Figure 9). We used the LBNL/NAESCO database of projects to determine that the median per-project investment level for the three largest ESCOs was nearly 40% higher than the per-project investment level for small to medium-sized ESCOs ($2.6 million compared to $1.9 million). It follows that larger ESCOs typically install larger, more comprehensive projects that involve multiple funding sources and complex financial arrangements, which make the use of financial advisors more important for these types of projects.

In what percentage of your [company's] projects during the past three years did the customer use third party professional financial advisors (e.g., bond counsel or financial consultant)?

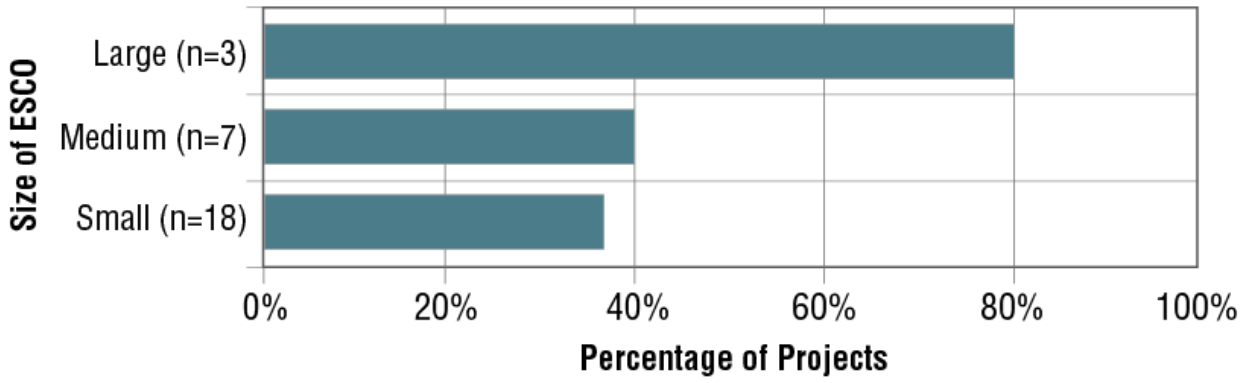

Figure 9. Median percent of projects involving third-party professional financial advisors (2009-2011)

Impact of Federal ARRA Programs

Thirty ESCOs also provided information about the use of programs that were authorized by, or received significantly increased funding from ARRA. In aggregate, eleven medium and large respondent ESCOs reported that approximately 30% of their projects in the last three years relied

[20] It is important to note that we have a relatively small sample of respondents for the large and medium-sized ESCOs.

on some type of federal programs (e.g., ARRA, revolving loan funds, QECBs). Less than 15% of the projects of nineteen small ESCOs incorporated federal stimulus dollars (see Figure 10).

What percentage of your [company's] projects have used federal stimulus programs including ARRA grants, other direct grants, revolving loans, QECBs, QZABs during the past three years?

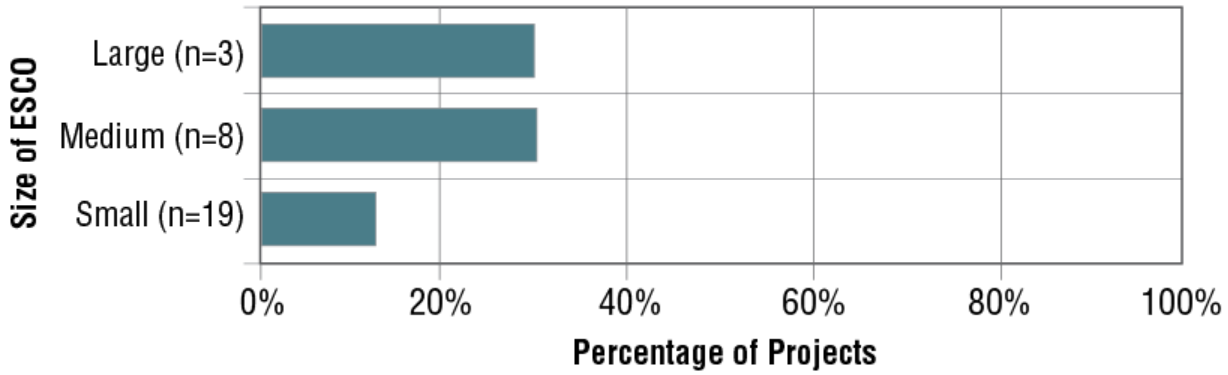

Figure 10. Median percent of projects that involved federal stimulus funding (2009-2011)

Local, State, or Federal Tax Credits

Twenty-nine ESCOs reported that some share of their projects incorporated local, state or federal tax credits during the last three years. Seven companies indicated that over half of their projects incorporated tax credits. One smaller ESCO indicated that 100% of its projects took advantage of the 179d tax provision that allows a public agency to assign the deduction to a project provider.[21] Five ESCOs reported that none of their projects leveraged tax incentives, while fourteen ESCOs reported that between one and ten percent of their projects used these incentives (see Figure 11).

What percentage of your [company's] projects have used local, state, or federal tax credits (e.g., Section 179d, Investment Tax Credit, Production Tax Credit) during the past three years?

[21] Please note that the 179d tax deduction has been updated for 2013.

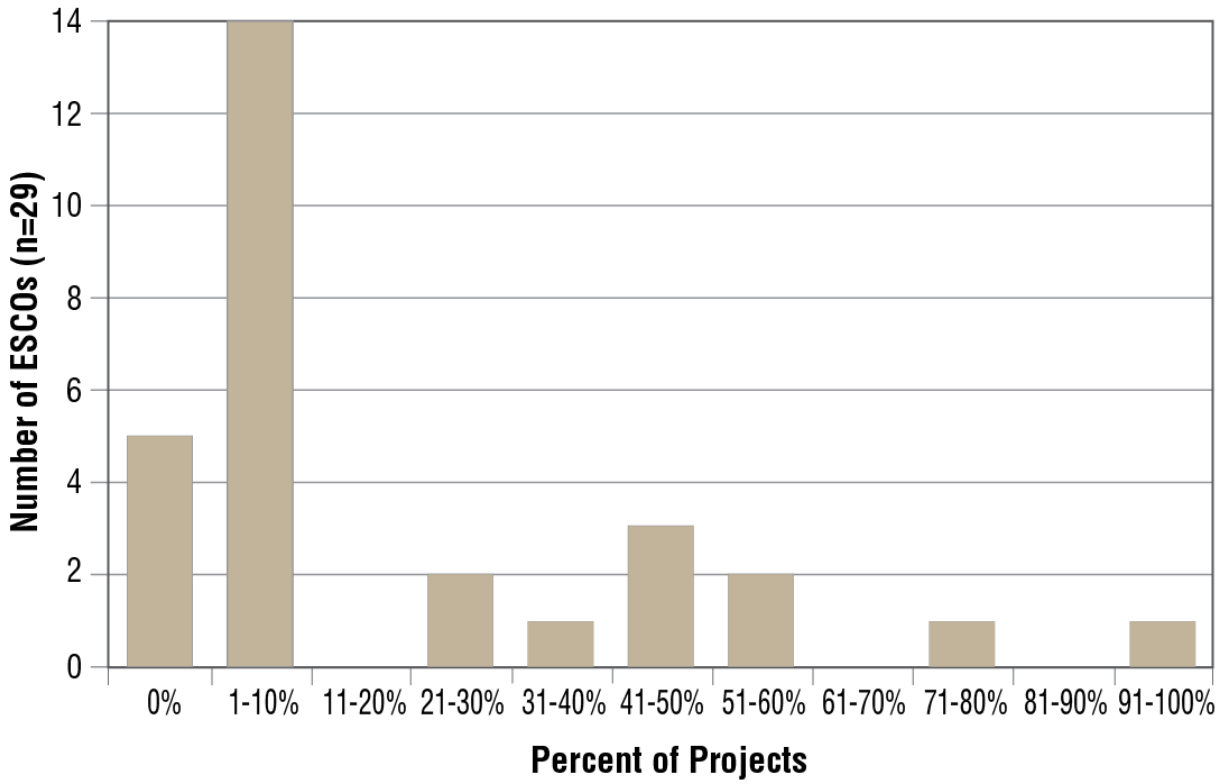

Figure 11. ESCO use of local, state or federal tax credits (2009-2011)

Utility Customer-funded Financial Incentives

Twenty-seven ESCOs reported that some portion of their projects used utility customer-funded financial incentives (e.g., rebates, no-cost or subsidized audits, engineering studies or technical assistance). Among the respondents, eighteen small ESCOs reported that in aggregate over 80% of their projects used utility incentives. One large ESCO noted that incentives from efficiency program administrators offset a very small percentage of the total project cost for their large projects. These findings suggest that these types of incentives may be particularly important to the economics of projects typically implemented by smaller ESCOs.

Financing Vehicles

We asked ESCOs to estimate the percentage share of their projects, for each market segment, that have used the following financing methods during the past three years (2009-2011): 1) 100% cash[22]; 2) partial cash[23]; 3) term loan; 4) state/local government bond issue; 5) lease; and 6) other financing vehicles (see Table 3). We highlight the following results.

[22] For government entities, cash is typically appropriated funds, usually from capital budgets. For private sector projects with paybacks of less than one year, the source of funds may come from annual operating budgets.
[23] For the purposes of this question, we defined "Partial Cash" as a mix of appropriated funds and debt.

First, nineteen ESCOs reported information about project financing in the federal government sector. In aggregate, about 40% of these federal projects used 100% cash, typically in the form of appropriated funds that were likely allocated as part of the ARRA or military services facility modernization budgets. About 19% of federal projects used leases, most commonly third party financing of capital or operational leases or lease purchase agreements. About 31% of federal projects used other methods of financing, most commonly a type of arrangement unique to the federal sector known as large scale securitization financing for energy assets (Hannon and Armstrong 2013). In this type of arrangement, the ESCO executes two contracts: one with the federal customer to provide guaranteed savings and another with a lender who provides the capital for the project. In this arrangement, a "special purpose entity" carries the liability.

Second, some K-12 school projects used cash or partial cash (about 15%), but ESCOs indicated that most K-12 schools employed either a state or local bond issuance or a lease arrangement (34% and 28% of projects, respectively). Third, ESCOs reported that state and local government customers used a broad range of financing vehicles, but state or local bonds and tax-exempt municipal leases were most common (31% and 23% of projects, respectively)[24] (see Table 3).

Table 3. Financing methods used by ESCO customers (2009-2011) [25]

Market Segment	Cash	Partial Cash	Term Loan	State/Local Bond	Lease	Other	Total
Federal (n=19)	40%	7%	0%	3%	19%	31%	100%
State/Local (n=24)	15%	14%	16%	31%	23%	0%	100%
K-12 Schools (n=25)	7%	8%	18%	34%	28%	5%	100%
Univ/College (n=23)	20%	16%	22%	22%	19%	0%	100%
Health/Hospital (n=16)	33%	16%	28%	1%	21%	1%	100%
Public Housing (n=6)	17%	3%	5%	4%	58%	13%	100%
C&I (n=16)	50%	4%	23%	2%	5%	16%	100%

Fourth, among private sector commercial customers, ESCOs reported that about 50% of their customers used cash to pay for projects and 16% used other types of financing. One example is an efficiency services agreement (ESA). ESAs are designed to increase uptake of energy efficiency in the private commercial sector.[26]

[24] Note that these numbers do not equate to the percentage of total project value. For example, a $1 million cash project and a $100 million financed project would each count as a single project in these results.
[25] Number of respondents are denoted with an "n =".
[26] An ESA has similar features to a power purchase agreement in that a third party provides capital for the project and takes ownership in the energy conservation measures for the length of the contract. The third party contracts with an ESCO (or other energy service provider) to develop the energy-saving project and provide long-term maintenance. The third party also contracts directly with the building owner who pays for the project at a specified price per unit of energy and operational cost savings. This structure enables energy efficiency to be treated as a service off of the balance sheet, rather than debt (Kats et al. 2012).

4. Remaining ESCO Market Potential

In this section, we present a preliminary estimate of the remaining market potential for the U.S. ESCO industry. We define the 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 ESCOs. Note that this definition excludes two factors that might significantly increase the potential market: the impact of new technologies that are more cost effective than current technologies and a second round of projects in buildings whose retrofits are now beyond their expected useful life.

4.1 Data Sources

We collected information from several sources to estimate remaining ESCO market potential:

- Interviews with ESCOs;
- The LBNL/NAESCO database of projects;
- A Delphi[27] process with industry experts; and
- The Energy Information Administration (EIA) 2003 Commercial Building Energy Consumption Survey (CBECS), the 2009 Residential Energy Consumption Survey (RECS); the General Services Administration (GSA) Federal Real Property Report; and other sources.

LBNL, in collaboration with NAESCO, has developed 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 (Larsen et. al., 2012a).[28] 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. In estimating remaining ESCO market potential, we used information from the LBNL/NAESCO database on typical project investment levels, energy, and dollar savings at the market segment level (e.g., K-12 schools, hospitals).

CBECS (DOE 2003) is a U.S. survey that describes the existing stock of U.S. commercial buildings. We used the results of this survey to determine the population of commercial buildings in 2003 (except for federal facilities and public housing). At the time this report was completed, 2003 was the most recent survey year available in CBECS. We used several sources (HUD 2013; CLPHA 2013; DOE 2009) to identify the existing population of public housing.

[27] 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 (e.g., see Hopper et al. 2007 and Linstone and Turoff 1975).
[28] See also Goldman et al. 2000; Goldman et al. 2002; Osborn et al. 2002; Hopper et al. 2005; Goldman et al. 2005; and Bharvikar et al. 2008. For detailed information about the content, structure and assumptions used in the database, see Larsen et al. (2012a).

The GSA (2003) Federal Real Property Report was used to estimate the floor area of federal facilities.

4.2 Approach

We define the 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 ESCOs.

The *Guide for Conducting Energy Efficiency Potential Studies* notes that there are several different types of energy efficiency "potential" and that different studies use similar terms in different ways (NAPEE 2007). The Guide provides typical 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.[29] Our estimate of total floor area available in the ESCO market is based on data from several sources (e.g., 2003 CBECS Survey, 2009 RECS Survey; GSA (2003); CLPHA (2013)). 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.

We define the 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 ESCOs. In other words, investment potential represents the upper-bound dollar amount that ESCOs could achieve in markets typically addressed by this industry. 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.

We developed an estimate of remaining ESCO investment potential across market segments in four basic steps: (1) estimate total floor area of ESCO-addressable buildings by market segment; (2) determine existing market penetration of non-residential energy efficiency retrofits in ESCO markets; (3) calculate typical investment levels and energy savings for the various market segments; and, finally, (4) estimate remaining market potential (see Figure 12).

[29] Most potential studies are undertaken in connection with utility customer-funded energy efficiency programs, so the maximum achievable potential is a function of the program design. The economics of ESCO projects are different, for a number of reasons, including the fact that they typically do not use the same baseline metrics for measuring savings. Energy efficiency programs often use current code (e.g., CA Title 24), while ESCOs use actual field conditions in estimating savings to customers. Thus, the reported savings or savings potential from a utility customer-funded program could be less than the savings potential of an ESCO project on the same facility because of differences in the assumed baseline energy consumption.

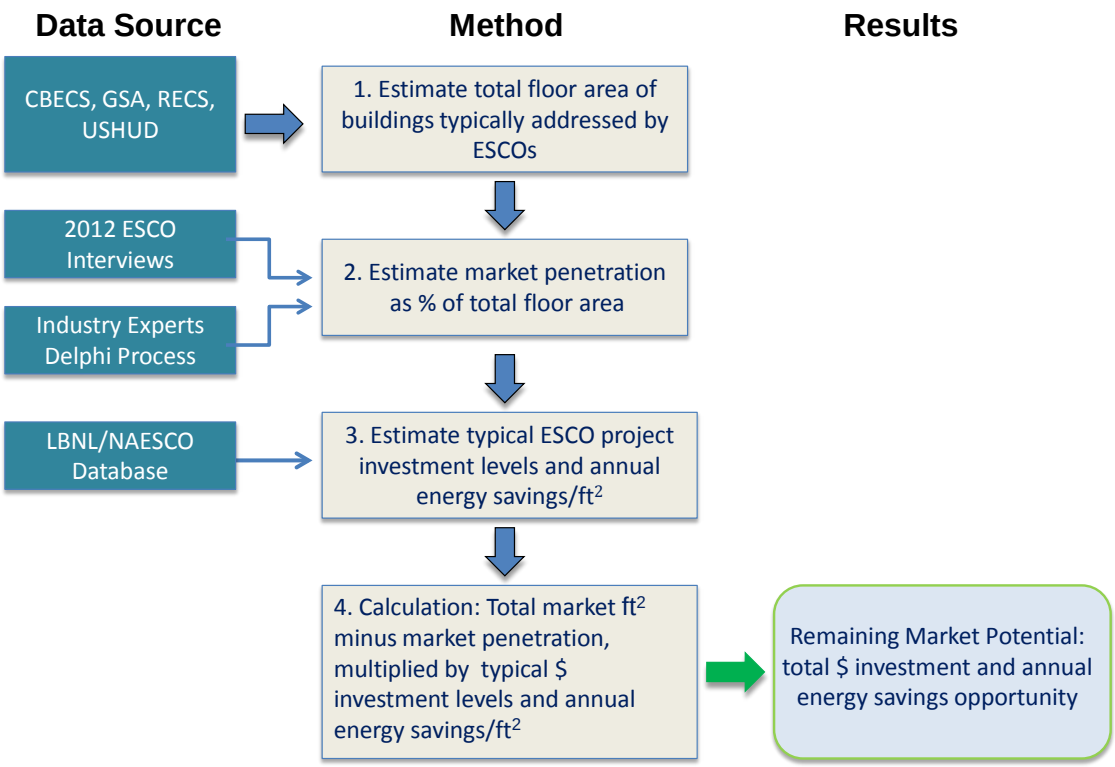

Figure 12. Flowchart illustrating methodology for estimating remaining potential for markets typically addressed by ESCOs

Total Market Size (floor area) of Non-residential Market Targeted by ESCOs
Step one (see Figure 12) involved compiling information on the population of U.S buildings and total floor area (ft^2) for each market segment using CBECS (DOE 2003), RECS (DOE 2009), HUD (2013), CLPHA (2013), and GSA (2003).[30]

In determining total market size, we explicitly attempt to account for this 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 that ESCOs primarily target opportunities in facilities larger than 50,000 ft^2 and that other types of energy efficiency service providers (e.g., lighting and mechanical contractors) were more likely to pursue retrofits in smaller buildings. We recognize that ESCOs often work in smaller buildings as part of larger projects that represent a number of buildings of various sizes to be retrofitted. However, for purposes of this analysis, we include only buildings greater than 50,000 ft^2. Thus,

[30] 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).

our estimate of the future population of buildings addressable by ESCOs is conservative because we exclude some opportunities that are technically feasible in buildings smaller than 50,000 ft^2 (see Appendix A for more information).

We also excluded non-owner-occupied large commercial buildings because they do not appear to be accessible to ESCOs because of the well documented problems of split incentives and the basic commercial real estate business model that has high hurdle rates for energy-related projects (e.g., short payback times). We excluded the residential, small commercial and industrial (C&I), and leased (i.e., rental) markets, because the ESCO business model has generally not been established in these sectors.

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 compiled information on public housing development unit counts from the Council of Large Public Housing Authorities (CLPHA) and average per-unit size from the Energy Information Administration's Residential Energy Consumption Survey (RECS).

We believe that CBECS (2012) may have under-counted the floor area of federal facilities. GSA (2003) reports floor area for federal facilities, but the overall share of facilities with a floor area greater than 50,000 ft^2 was not specified. In this case, we used the share of federal floor area greater than 50,000 ft^2 from CBECS (2012) and multiplied this value by the aggregate floor area reported by GSA (2003) to determine the total floor area of federal facilities larger than 50,000 ft^2.

Table 4 shows that private commercial buildings account for about 7.3 billion ft^2 (or 33.6%) of the ~22 billion ft^2 of ESCO-addressable floor area. In the public sector, K-12 schools account for the largest portion (23% of the total), followed by the federal sector (11%), state and local government buildings (11%), healthcare buildings (10%), universities and colleges (6%) and public housing (~5%).

Table 4. Estimated total floor area (ft2) of ESCO-addressable buildings by market segment in 2003[31,32]

Market Segment	Floor Area: 2003 (million ft^2)	% of Total Floor Area: 2003
Private Commercial	7,385.7	33.6%
K-12 Schools	5,113.4	23.3%
Federal	2,494.9	11.4%
State/Local	2,326.3	10.6%
Health/Hospital	2,244.0	10.2%
Universities/Colleges	1,353.6	6.2%
Public Housing	1,056.7	4.8%
Total	**21,974.7**	**100.0%**

[31] Note: Total values in some tables may not add up due to rounding errors.
[32] Public Housing floor area is based on 2009 RECS (DOE 2009).

Existing ESCO Penetration

Step two relies on ESCO industry respondents' estimates of market penetration and the judgment of our ESCO industry experts. We asked the ESCOs to estimate the percentage of each market segment (number of buildings or square footage) in their service area that has received energy efficiency retrofit work since 2003. [33] We used 2003 as the base year for the discussion, because the latest CBECS survey provided floor area information as of 2003, which is the best available national "snapshot" of commercial buildings information. Twenty-one ESCOs provided market penetration estimates. Most ESCOs provided estimates only for the customer market segments they serve. Respondent ESCOs represent approximately 50% of the existing ESCO market in terms of industry revenues and included both large and small companies.[34] We also compiled market penetration from three ESCO industry experts through a Delphi process and included each of those responses in our calculation of the median penetration rate.

We calculated the median value provided by ESCOs of market penetration responses for each market segment and each U.S. Census region (see Table 5). We observe that estimated market penetration is generally highest for the K-12 schools and state and local government sectors (42% and 30%, respectively). Performance contracting has long been attractive to public and institutional customers as a way to provide capital improvements, including non-energy improvements (e.g., roof replacements and asbestos abatement) that are particularly important to school facilities, without requiring upfront capital or a voter-approved bond issuance. The federal sector follows, with a very consistent estimated market penetration across regions, ranging from 25% in the South to 28% in the Midwest. Market penetration in the Northeast is typically higher for most market segments when compared to the rest of the U.S. In the Western U.S., ESCOs report that they have penetrated the state/local government market at higher levels than the U.S. average, but at lower levels for the K-12 schools market. Somewhat surprisingly, ESCOs report that market penetration levels in the South are comparable to the U.S. average for various market segments. ESCOs report relatively low market penetration rates (<10%) in private commercial buildings.

[33] We assumed that ESCOs would be most knowledgeable about market penetration for their particular service area(s). These responses allowed us to correlate ESCO estimates of market penetration with CBECS data, which is disaggregated by U.S. Census region: Northeast, Midwest, South and West (U.S. Census 2012).

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

Table 5. Median ESCO market penetration estimates: % of total market floor area addressed by performance-based contracts since 2003[35]

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%

We multiplied each market penetration estimate by the total square footage of that market segment for each region (presented in Table 6) to convert market penetration estimates to floor area that has received a performance contracting retrofit since 2003. As a result of this process, we estimate that the total floor area that has been addressed by performance contracts since 2003 totals ~4.9 billion ft^2. K-12 school buildings make up the largest share (about 43%) of total floor area addressed, with a total floor area of over 2 billion ft^2 estimated to have received retrofits in the past ten years. Federal and state/local government buildings make up the second and third largest share of total floor area addressed (just under 700 million ft^2 each). While the percentage of market penetration of the private commercial sector is significantly lower than other market segments (Table 5), because the total market size for commercial is vast (Table 3), we found that there was a significant amount of retrofitted floor area in the commercial sector, nearly as much as each of the government sectors (see Table 6).

Table 6. Estimated total floor area (million ft2) of buildings that have received performance-contracting retrofit projects since 2003

Market Segment	Floor Area Retrofitted: 2003-2012 (million ft^2)	% of Total Floor Area Retrofitted: 2003-2012
K-12 Schools	2,147.6	43.3%
Federal	698.6	14.1%
State/Local	697.9	14.1%
Private Commercial	664.7	13.4%
Universities/Colleges	338.4	6.8%
Health / Hospitals	224.4	4.5%
Public Housing	190.2	3.7%
Total	**4,961.8**	**100.0%**

[35] Median penetration rates for some census regions (most notably for the K-12 schools and state/local markets) differ from the U.S. median due to a small number of outlier estimates for those regions.

Typical ESCO Project Investment and Savings Levels

Step three involved analyzing typical investment and savings information from the LBNL/NAESCO database for retrofit projects completed from 2003 through 2012. Specifically, we calculated median project installation costs without financing charges and the effects of incentive payments (dollars/ft^2) and median annual energy savings (MMBtu savings/ft^2) for each market segment and region (see Technical Appendix A).

Remaining Investment 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 ($/ft^2) and annual blended energy savings (MMBtu/ft^2) to determine total ESCO market size in terms of dollar value of investment opportunity and annual energy savings. Next, we multiplied total floor area that has been addressed (from step 2) by typical project cost ($/ft^2) and annual energy savings (MMBtu/ft^2) 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 market (and 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).[36]

Summary of Key Assumptions

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 50,000 ft^2 (see Table 7). *For these reasons, we view our estimates of remaining market potential for the ESCO industry as an initial, conservative estimate that could be refined with better and more recent data*.

[36] See Technical Appendix A for more information.

Table 7. 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/ft^2; MMBtu/ft^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	ft^2	CBECS/DOE (2003)	Excluded buildings < 50,000 ft^2; commercial buildings only include owner-occupied facilities.
Population of public housing facilities	ft^2	RECS/DOE (2009); CLPHA (2013)	Floor area based on 2009 data from EIA RECS survey and coun.
Population of federal buildings	ft^2	GSA (2003) and CBECS/DOE (2003)	Comprises owner-occupied federal facilities greater than 50,000 ft^2. GSA (2003) was used to determine total floor area. CBECS/DOE (2003) was used to determine *share* of federal owner-occupied facilities greater than 50,000 ft2.
Typical floor area of building by market segment	ft^2	CBECS/DOE (2003)	Used in conversion of number of buildings addressed to percentage of market segment addressed

4.3 Estimate of Remaining ESCO Market Potential

Table 8 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. This is indicative of an average market penetration of ~25% for all U.S. market segments (see Table 5). This preliminary analysis found that there is still a considerable opportunity for ESCO activity in all market segments.

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 13 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).

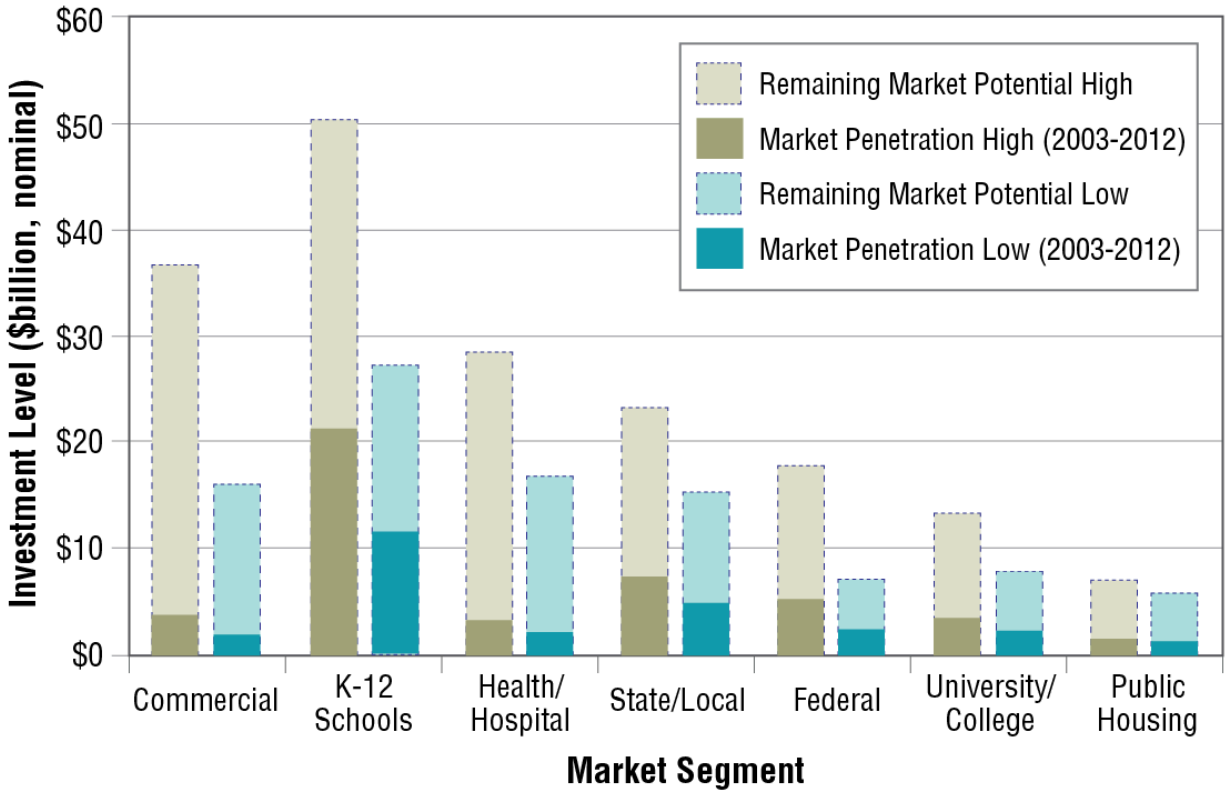

Figure 13. Range of estimated existing market penetration (2003-2012) and remaining ESCO market potential by market segment

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.

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**

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. Nakagami (2010), who defines ESCOs in a similar fashion, reported that these companies were first introduced into Asia in the 1990s—based in part on the U.S. business model. Nakagami reported that China's performance contracting market totaled just over $1.6 billion in 2008. Interestingly, a forthcoming report from the European Joint Research Center (JRC) found that China's performance contracting industry has grown to $4-$7 billion in 2012 (Cahill and Bertoldi 2013).[37] Japan, the next largest market for ESCOs in Asia, was a distant second at ~$170 million.

In contrast, ESCOs have a long history in Europe, though the industry has had relatively lower growth rates when compared to the United States. Cahill and Bertoldi (2013) have developed new estimates of ESCO industry size in some European states, based on a 2012 global survey of ESCO industry executives. Marino et al. (2010) 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 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 (Marino et al. 2010). 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.

Table 10. ESCO industry size estimates by selected country

Country	Estimated ESCO Industry Size ($ million)	Source
China	$4,000-$7,000	Cahill and Bertoldi (2013)
United States	~ $5,300	Stuart et al. (2013)
Germany	~$3,900-$5,200	Cahill and Bertoldi (2013)[38]
France	~$4,000 - $5,000	Marino et al. (2010)

[37] Respondents to the JRC survey indicated that, in contrast to the U.S. and much of the rest of the world, the ESCO market in Japan and South Korea is stagnant or has been in decline in recent years.

[38] The results from the European Joint Research Centre are preliminary and may be revised once the authors have completed a more in-depth analysis (Cahill and Bertoldi 2013). All JRC estimates reported in Euros were converted to U.S. Dollars at an exchange rate of $1.288 per Euro.

Country	Estimated ESCO Industry Size ($ million)	Source
United Kingdom	~$320	Cahill and Bertoldi (2013)
Italy	~$600	Cahill and Bertoldi (2013)
Spain	$390-$500	Cahill and Bertoldi (2013)
Switzerland	~$170-$300	Marino et al. (2010)
Denmark	$180-$190	Cahill and Bertoldi (2013)
Japan	~$170	Nakagami (2010)
Romania	~$50	Marino et al. (2010)

Although ESPCs are making inroads in these markets, many European countries (e.g., U.K., Spain and Switzerland) report primarily using the "chauffage" financial model (Marino et al. 2010) 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.

6. Conclusion

This study builds on previous ESCO industry reports and provides updated estimates of ESCO industry and market segment revenues and recent and projected growth trends, and an estimate of the remaining investment potential in markets typically served by the ESCO industry.

The U.S. ESCO industry continued to grow at a steady pace--despite the onset of a major recession--reporting revenues of ~$5.3 billion in 2011. The ESCO industry is expected to continue to grow through 2014 at about the same pace it grew from 2009-2011. By the end of the decade, we project that the ESCO industry could double or almost triple in size from $5.3 billion in 2011 to $10.6-$15.3 billion in 2020.

We found that public and institutional markets accounted for about 84% of ESCO industry revenue in 2011—consistent with results reported in our last study. Interestingly, ESCOs reported a significant decline in revenue from renewable and other onsite generation projects since 2008. We estimate that the remaining investment potential in facilities typically addressed by the ESCO industry is significant, ranging from ~$71 to $133 billion.

ESCOs reported that a significant share of projects involved using a third-party financial advisor, with larger ESCOs observing a larger share of projects with advisors. Projects carried out by medium-sized ESCOs were more likely to use local, state, or federal tax incentives.
As utility customer-funded program administrators and state regulators look for ways to meet aggressive energy-savings targets, future partnership opportunities with ESCOs should be considered. In addition, state and federal-level policies that require performance-based contracting will continue to be an important driver of ESCO activity. Policies that increase energy and water prices (or put prices on pollution) may also stimulate demand for comprehensive retrofits. Furthermore, policies that allow public/institutional customers to address non-energy, deferred maintenance issues (e.g., roof replacement, wiring, asbestos) with performance-based contractors will also facilitate additional industry growth.

LBNL will continue to explore these and other timely issues that affect the evolution of this important industry.

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Appendix A. Remaining Market and Industry Potential: Approach and Key Data Sources

This appendix contains additional information on the approach and data used to calculate the remaining market potential for the U.S. ESCO industry.

A.1 Method to Estimate Remaining Market and Industry Potential

Equations 1-3 describe the method used to estimate remaining potential (MP) for market segment *i* in investment dollars (INV) and annual energy savings (ESAVE), respectively:

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

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

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

It follows that aggregate ESCO industry potential (EIP) is the summation of all market segment potentials for each industry potential metric (investment dollars and annual energy savings):

$$EIP_INV = \sum_{i=1}^{7} MP_INV_i \quad (3)$$

$$EIP_SAVE = \sum_{i=1}^{7} MP_SAVE_i \quad (4)$$

A.2 Key Data Sources

Market Penetration Estimates (PEN)
We asked ESCOs to estimate the percentage of the market in the ESCOs' service area, for various market segments, 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. We applied each ESCOs market penetration estimate across each of the U.S. Census regions included in that ESCOs 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 A-1).

Table A- 1. Median ESCO market penetration estimates: % of total market floor area 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%

The market penetration percentages were applied to the aggregate floor area of non-residential buildings typically addressable by ESCOs to determine the remaining amount of floor area potentially eligible for a retrofit within each market segment.

Aggregate Floor Area of Buildings (BPOP) Typically Addressable by ESCOs

We compiled information on total building floor area by market segment using the 2003 Energy Information Administration (EIA) Commercial Building Energy Consumption Survey (CBECS/DOE 2012), General Services Administration (GSA 2003), and United States Department of Housing and Urban Development (HUD 2013). [39]

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 buildings in the U.S. (i.e., population of commercial buildings). The Department of Energy (DOE) Buildings Energy Data Book provides a query tool to access CBECS micro data (DOE 2012). Table A-2 presents the query parameters that we used to compile the total floor area of "ESCO-addressable" buildings by market segment. We consider a public building to be ESCO-addressable if it is larger than 50,000 ft^2. We consider private commercial buildings to be ESCO-addressable if they are greater than 50,000 ft^2 *and* owner-occupied. As discussed earlier, principal-agent issues create high barriers to completing energy efficiency upgrades in leased buildings (IEA 2007).

Table A- 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

[39] The 2003 CBECS database is the most recent comprehensive source of information on commercial building population in the U.S.; an updated survey is planned for 2013.

Market Segment	Query Parameters		
	Ownership	**Building Type**	**Square Footage**
State/Local	State + Local	Office, Public Assembly, Religious Worship, Food Sales, Nonrefrigerated Warehouse, Food Service, Lodging– Hotel, Lodging– Motel, Retail Other Than Mall, Service, Public Order and Safety	>= 50,001 ft^2
K-12 Schools	(No selection)	Elementary, High School, Preschool	>= 50,001 ft^2
University / College	(No selection)	Education– College, Lodging– Dormitory	>= 50,001 ft^2
Healthcare / Hospital	(No selection)	Outpatient Health Care, Hospital	>= 50,001 ft^2
Private Commercial[40]	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	>= 50,001 ft^2

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 \$5.44/ ft^2. Next, we compiled information on public housing development size and unit counts from the Council of Large Public Housing Authorities (CLPHA) and the Energy Information Administration's Residential Energy Consumption Survey (RECS). We found that there were a total of 1,164,972 public housing units in 2000 (CLPHA 2013). We multiplied the number of units by the per-unit average square

[40] 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 50,001 ft^2 and owner-occupied.

footage (907 ft^2) for public housing units from the RECS (DOE 2009). This resulted in an estimate of ~1.06 billion ft^2 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 (DOE 2003) survey may have under-estimated the floor area of federal facilities. We believe that GSA (2003) estimates of floor area for federal facilities are more accurate, because GSA is a comprehensive inventory of federal facility information. Unfortunately, the overall share of facilities with a floor area greater than 50,000 ft^2 was not specified. In this case, we used the share of federal floor area greater than 50,000 ft^2 from CBECS (DOE 2003) and multiplied this value by the aggregate floor area reported by GSA (2003) to determine the total floor area of federal facilities larger than 50,000 ft^2.

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

Table A- 3. Estimate of total floor area of ESCO-addressable buildings

Market Segment	CBECS Sample Size	Number of Buildings (Units)	Average Floor Area (ft^2) per Building (Unit)	Total Floor Area (million ft^2)
Private Commercial	331	48,174	153,315	7,385.7
K-12 Schools	236	48,738	104,916	5,113.4
Federal	N/A	N/A	N/A	2,494.9
State/Local	113	18,542	125,463	2,326.3
Health and Hospital	254	11,504	195,060	2,244.0
Universities/Colleges	70	11,236	120,474	1,353.6
Public Housing	N/A	1,164,972	907	1,056.7
Total				**21,974.7**

We multiplied the estimated floor area of ESCO-addressable buildings that have received retrofits since 2003 (Table A-3) by typical project investment level/ft^2 and typical project energy savings/ft^2 (Btu) from the LBNL/NAESCO project database (see Table A-8 in this appendix).

Accordingly, we estimated that the aggregate value of the U.S. ESCO market in 2003 (i.e., project investment opportunity) was ~$95 to $177 billion ($2012). We subtracted those results from the aggregate value of the U.S. market in 2003 to derive our estimate of *remaining* ESCO investment potential by market segment.

Tables A-4 (low estimate) and A-5 (high estimate) show 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. This is indicative of an average market penetration of ~25% for all U.S. market segments (see Table 3, above).

Table A- 4. Estimated remaining U.S. ESCO market potential: Low estimate (2012 dollars)

Market Segment	2003 ESCO Market Potential ($ billion)	-	ESCO Market Penetration 2003-2012 ($ billion)	=	*Remaining* ESCO Market Potential ($ billion)
K-12 Schools	$27.3		$11.4		$15.8
Health/Hospital	$16.7		$1.7		$15.0
Private Commercial	$15.8		$1.4		$14.4
State/Local	$15.2		$4.5		$10.6
Universities/Colleges	$7.6		$1.9		$5.7
Federal	$6.8		$1.9		$4.9
Public Housing	$5.7		$1.0		$4.7
Total	**$95.1**		**$23.9**		**$71.2**

Table A- 5. Estimated remaining U.S. ESCO market potential: High estimate (2012 dollars)

Market Segment	2003 ESCO Market Potential ($ billion)	-	ESCO Market Penetration 2003-2012 ($ billion)	=	*Remaining* ESCO Market Potential ($ billion)
Private Commercial	$36.9		$3.3		$33.5
K-12 Schools	$50.6		$21.3		$29.4
Health/Hospitals	$28.5		$2.8		$25.6
State/Local	$23.2		$7.0		$16.3
Federal	$17.6		$4.9		$12.7
Universities/Colleges	$13.1		$3.3		$9.8
Public Housing	$6.9		$1.2		$5.7
Total	**$176.8**		**$43.8**		**$133.0**

Tables A-6 (low estimate) and A-7 (high estimate) show that the remaining annual energy savings potential for the U.S. ESCO industry ranges from about ~354 trillion to ~519 trillion Btu.

Table A- 6. Estimated annual energy savings potential (low estimate)

Market Segment	2003 Market Total Annual Blended Energy Savings Potential (trillion Btu)	-	ESCO Market Annual Blended Energy Savings Achieved 2003-2012 (trillion Btu)	=	*Remaining* Annual Blended Energy Savings Potential (trillion Btu)
Private Commercial	140.3		12.6		127.7
Health/ Hospital	94.2		9.4		84.8
K-12 Schools	71.6		30.1		41.5
State/Local	55.8		16.7		39.1
Federal	37.4		10.5		26.9
Universities/Colleges	25.7		6.4		19.3
Public Housing	18.0		3.2		14.8
Total	**443.1**		**89.0**		**354.2**

Table A- 7. Estimated annual energy savings potential (high estimate)

Market Segment	2003 Market Total Annual Blended Energy Savings Potential (trillion Btu)	-	ESCO Market Annual Blended Energy Savings Achieved 2003-2012 (trillion Btu)	=	*Remaining* Annual Blended Energy Savings Potential (trillion Btu)
Private Commercial	206.8		18.6		188.1
Health/ Hospital	110.0		11.0		99.0
Federal	94.8		26.5		68.3
K-12 Schools	102.3		43.0		59.3
State/Local	79.1		23.7		55.4
Universities/Colleges	39.3		9.8		29.4
Public Housing	23.2		4.2		19.2
Total	**655.4**		**136.8**		**518.7**

A.3 Typical ESCO Project Characteristics

The final step in compiling information for the market potential study 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") (1) dollar investment level per square foot and (2) annual energy savings per square foot– disaggregated by the seven market segments. See Appendix A of Larsen et. al. (2012a) 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 A-1 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 A-2). 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.

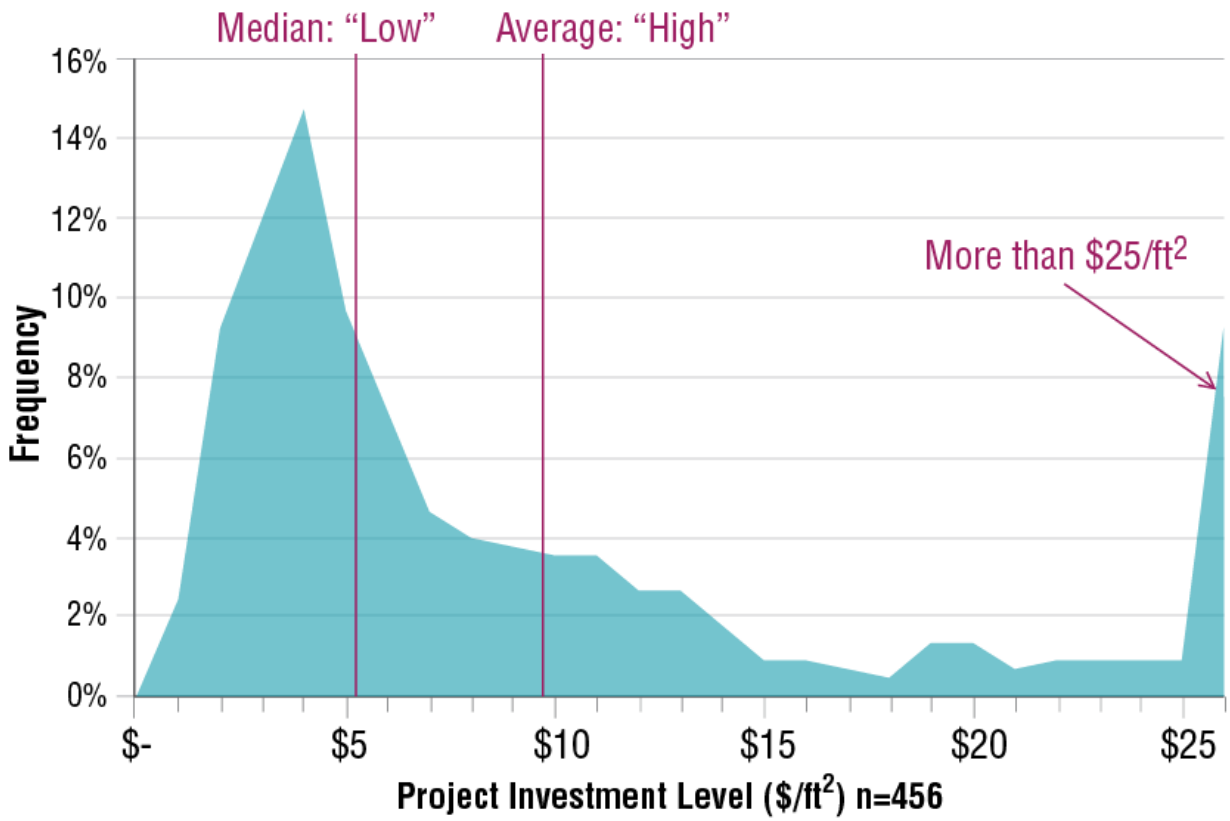

Figure A- 1. Range of K-12 schools project investment levels (2003-2012)

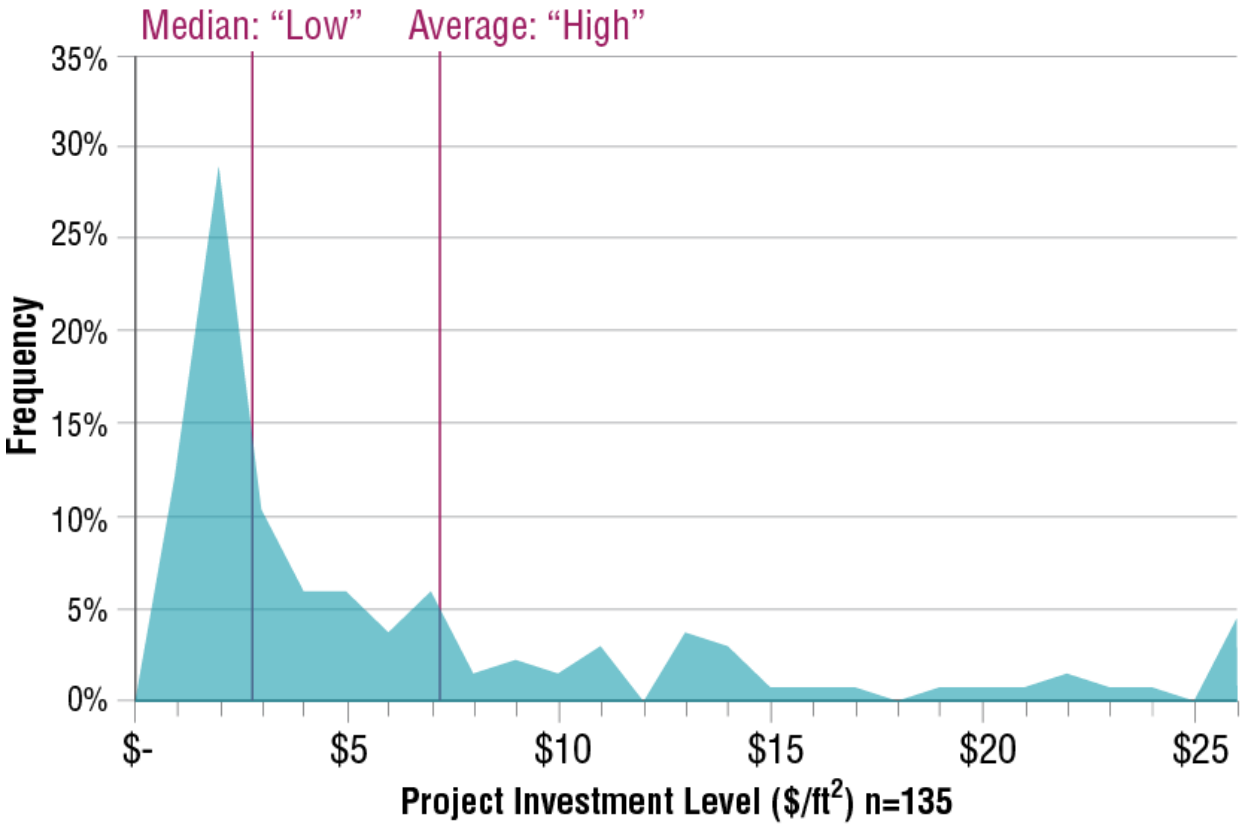

Figure A- 2. Range of federal project investment levels (2003-2012)

Table A-8 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.

Table A-8. Median ("low") and average ("high") per-project investment and savings levels by market segment (2003-2012)

Table A- 8. Median ("low") and average ("high") per-project investment and savings levels by market segment (2003-2012)

Market Segment	Median Project Installation Cost ($/ft^2)	Average Project Installation Cost ($/ft^2)	Median Project Blended Energy Savings (MMBtu/ft^2)	Average Project Blended Energy Savings (MMBtu/ft^2)
Federal Government	$2.72 (n=135)	$7.06 (n=135)	0.015 (n=96)	0.038 (n=96)
State/Local Government	$6.52 (n=231)	$9.99 (n=231)	0.024 (n=185)	0.034 (n=185)
K-12 Schools	$5.33 (n=456)	$9.90 (n=456)	0.014 (n=375)	0.020 (n=375)

Market Segment	Median Project Installation Cost ($/ft^2)	Average Project Installation Cost ($/ft^2)	Median Project Blended Energy Savings (MMBtu/ft^2)	Average Project Blended Energy Savings (MMBtu/ft^2)
Universities/ Colleges	$5.64 (n=157)	$9.67 (n=157)	0.019 (n=117)	0.029 (n=117)
Health/ Hospital	$7.45 (n=72)	$12.70 (n=72)	0.042 (n=49)	0.049 (n=49)
Public Housing	$5.44 (n=31)	$6.55 (n=31)	0.017 (n=24)	0.022 (n=24)
Commercial/ Industrial	$2.14 (n=43)	$4.99 (n=43)	0.019 (n=34)	0.028 (n=34)

Source: LBNL/NAESCO database of projects (see Larsen et al. 2012a).

A.4 Long-term Industry Growth Projections

We also developed three alternative scenarios to project long-term ESCO industry growth to 2020:

- High case: industry growth rates extrapolated to 2020 based on ESCOs projected growth rates for 2012-2014 (12.6% compounded annually);
- Medium case: industry growth rates extrapolated to 2020 based on an LBNL approach that adjusts ESCO industry growth rates based on observed differences between actual historic and projected growth rates; and
- Low case: industry growth rates extrapolated to 2020 based on actual 2008-2011 industry growth rates (8.3% compounded annually).

The "high case" begins with a ~$5.3 billion reported revenue estimate (2011) and incorporates a 12.6% growth rate compounding annually through 2020. The 12.6% annualized growth rate is based on what the ESCO industry expects annual growth rates will be from 2012-2014.

For the "medium case," LBNL researchers determined the degree to which industry projections tended to be overly-optimistic in the past (Satchwell et al. 2010; Hopper et al. 2007) and adjusted for these optimistic forecasts. For example, we found that the upper-bound ESCO industry revenue growth rate projections originally made in 2006--for 2008--were ~16% higher than the growth rates that actually materialized in 2008. Furthermore, upper-bound revenue growth rate projections made in 2008--for 2011--were ~12% higher than growth rates actually reported for 2011. Equation 5 describes how future revenues were determined using this biased-weighted correction method:

$$LBNL_Revenue_{i+1} = Revenue_i * \left(1 + \left(\left(1 - \frac{(2*Bias_{2006-2008})+(3*Bias_{2008-2011})}{5}\right) * Annual_Growth_Rate_{2012-2014}\right)\right) \quad (5)$$

where $LBNL_Revenue_{i+1}$ is revenue in year i + 1; $Revenue_i$ is revenue in a base year; $Bias_{2006-2008}$ is the difference in ESCO industry growth rate projections for 2008 compared to actual growth rates in 2008 (i.e., 16%); $Bias_{2008-2011}$ is the difference between ESCO industry growth rate projections for 2011 originally made in 2008 compared to reported growth rates for 2011 (i.e., 12%); and $Annual_Growth_Rate_{2012-2014}$ is the annual projected growth rate made by the ESCO industry for 2012-2014 (i.e., 12.6%). A ~$5.3 billion industry size estimate is assumed for the base year (2011).

Finally, the "low case" is based on a ~$5.2 billion industry size estimate (2011) and escalated using the 2008-2011 observed annual "low range" growth rate of 8.3% compounded annually.

Based on these assumptions, we anticipate that ESCO industry revenues will more than double in size from ~$5.2-5.3 billion (2011) to $10.6-$15.3 billion by 2020 (see Figure 4 in the main body of the text).