Estimating customer electricity savings from projects installed by the U.S. ESCO industry

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Executive Summary

The U.S. energy service company (ESCO) industry has a well-established track record of delivering substantial energy and dollar savings in the public and institutional facilities sector, typically through the use of energy savings performance contracts (ESPC) (Larsen et al. 2012; Goldman et al. 2005; Hopper et al. 2005, Stuart et al. 2013). This ~$6.4 billion industry, which is expected to grow significantly over the next five years, may play an important role in achieving demand-side energy efficiency under local/state/federal environmental policy goals. To date, there has been little or no research in the public domain to estimate electricity savings for the entire U.S. ESCO industry. Estimating these savings levels is a foundational step in order to determine total avoided greenhouse gas (GHG) emissions from demand-side energy efficiency measures installed by U.S. ESCOs.

We introduce a method to estimate the total amount of electricity saved by projects implemented by the U.S. ESCO industry using the Lawrence Berkeley National Laboratory (LBNL) /National Association of Energy Service Companies (NAESCO) database of projects and LBNL's biennial industry survey. We report two metrics: incremental electricity savings and savings from ESCO projects that are active in a given year (e.g., 2012).

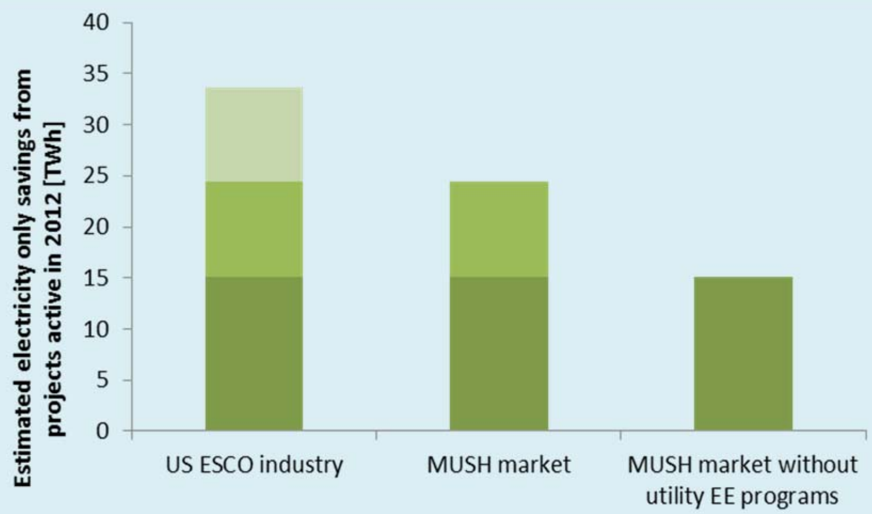

Figure 1. Estimated electricity savings from U.S. ESCO projects that were active in 2012

Overall, we estimate that in 2012 active U.S. ESCO industry projects generated about 34 TWh of electricity savings—15 TWh of these electricity savings were for MUSH market customers who did not rely on utility customer-funded energy efficiency programs (see Figure 1). This analysis shows that almost two-thirds of 2012 electricity savings in municipal, local and state government facilities, universities/colleges, K-12 schools, and healthcare facilities (i.e., the so-called "MUSH" market) were not supported by a utility customer-funded energy efficiency program.

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Introduction

The U.S. energy services company (ESCO) industry has long been recognized for its role in project development and implementation services and in obtaining private-sector financing for energy efficiency and other "clean energy" investments and related energy services to customers with large and medium-sized facilities.

ESCOs have had the most success targeting customers in the public and institutional facilities sector, typically through the use of ESPCs (Larsen et al. 2012; Goldman et al. 2005; Hopper et al. 2005, Stuart et al. 2013). ESPCs allow public entities to implement equipment and facility upgrades to achieve energy and water savings with little or no up-front investment and offer another (often quicker) option than waiting for the appropriation of public funds (Bingaman et al. 2014).

We follow Larsen et al. (2012) and define an 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."*

The U.S. ESCO industry reported annual revenues of $5.3 billion in 2011 with revenues expected to grow to ~$6.4 billion by the end of 2013 (Stuart et al. 2013). Stuart et al. (2013) also estimated a remaining market potential of $77 billion to $133 billion in facilities commonly serviced by ESCOs.

Given this context, state policy makers could consider implementing or expanding various types of policies and initiatives that support demand-side energy efficiency, such as energy efficiency resource standards (EERS), ESPC for designated market segments, building energy codes, retrofit on sale ordinances, and financing, among others. In this policy brief, we estimate incremental annual electricity savings and savings for projects active in a given year developed and implemented by U.S. ESCOs. Estimating these savings levels is a foundational step in order to determine total avoided GHGs from energy efficiency measures installed by U.S. ESCOs. ESCOs also report whether customers receive financial incentives from a utility customer-funded program. This allows stakeholders to disaggregate savings further and illustrates that we have the information and tools to avoid potential double-counting of savings (and GHG emissions) from projects developed by ESCOs.

Questions

This policy brief addresses three specific questions:

1. What are the total electricity savings for U.S. ESCO industry projects implemented in recent years?
2. What fraction of those savings came from public/institutional customers that are covered by state (or local) legislation that supports performance-based contracts?
3. What fraction of ESCO projects that target public/institutional customers do not utilize financial incentives or participate in utility customer-funded efficiency programs?

Key Data Sources

For the past 15 years, LBNL has actively managed a database of U.S. ESCO projects, which currently contains 5,200+ projects representing over $12 billion in aggregate industry investment. We also conduct biennial surveys to determine the current and projected size of the U.S. ESCO industry (Goldman et al. 2002; Hopper et al. 2007; Satchwell et al. 2010; and Stuart et al. 2013). We used these two data sources to estimate electricity savings provided by ESCOs in recent years.

We estimate that the LBNL/NAESCO database contains about 18% of the existing ESCO market by revenue—since its inception. ESCO projects tend to be relatively homogenous (Hopper et al. 2005) and all ESCOs that are members of NAESCO, the industry trade association, provide a sample of their projects to LBNL as part of the NAESCO voluntary accreditation process for performance contractors (Larsen et al. 2012). Thus, we are reasonably confident that projects in the LBNL/NAESCO database are representative of current industry practices and performance[1], particularly those projects that target public/institutional customers.

Approach

Electricity savings calculation

We estimate electricity savings from ESCO projects that have been implemented in recent years using the following approach. First, we determine the electricity savings for all U.S. projects in the LBNL/NAESCO database that provided information on actual (reported) electricity savings in millions of British thermal units (MMBtu) or kilowatt-hours (kWh) or, in its absence, reported guaranteed electricity savings.[2] Then, we convert reported MMBtu to MWh using the standard site energy conversion rate of 1 kWh = 3,412 Btu.

Next, we use estimates of the size of the U.S. ESCO industry from Stuart et al. (2013) to scale up the calculated electricity savings from projects in the LBNL/NAESCO database to obtain estimates of electricity savings from ESCO industry projects in aggregate. Specifically, we divide the total project investment level (i.e., project installation costs) from the sample of projects in the LBNL/NAESCO database by market size estimates from Stuart et al. (2013) to obtain an estimate of the ESCO market that was represented in the LBNL/NAESCO database compared to the total U.S. ESCO market in a given year. Finally, we use the inverse of this ratio and multiplied by annual electricity savings from the sample of projects in the LBNL/NAESCO database to estimate annual aggregate ESCO industry electricity savings, as follows:

$$\text{ESCOSvgs}_t = \text{SampleElecSvgs}_t \times \left(\frac{1}{\left(\frac{\text{SampleProjectCost}_t}{\text{IndustryProjectCost}_t} \right)} \right), t = 2003 \ldots 2012 \qquad (1)$$

See Appendix A for a more detailed explanation of other key assumptions in our approach.

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[1] Approximately 70% of ESCO projects in the LBNL/NAESCO database are ESPCs.

[2] We exclude ESCO projects that did not report installation costs.

Fraction of savings from public/institutional sector market

We select the subset of projects in the ESCO database that targeted customers in the public/institutional sector that could be eligible for a state government performance contract program. We sum the electricity savings from these projects in each year to determine electricity savings for MUSH market customers and compare it to total electricity savings for all projects in the ESCO database. We estimate that public/institutional sector projects account for about 75% of all electricity savings achieved by U.S. ESCOs during the 2003-2012 period.

Participation in utility customer- funded efficiency incentive programs

ESCOs are asked whether they utilized or customers received financial incentives from a utility customer-funded efficiency program when they provide project information that is entered into the LBNL/NAESCO database. We segment public/institutional sector projects in the database into two groups: (1) projects where customers (or ESCOs) received a financial incentive from a utility customer-funded energy efficiency program; and (2) projects where ESCOs indicated that the project did not leverage financial incentives from such programs. We then calculate electricity savings for the projects in these two groups. Given the relatively small number of MUSH market projects in the LBNL/NAESCO database in 2012, we decided to use data for a longer time frame (the last 10 years for which we have data, or 2003-2012) to get a more representative picture of the extent to which ESCO projects utilize and access utility customer-funded rebates or financial incentives. We find that approximately 64% of public/institutional sector projects in the LBNL/NAESCO database did *not* report utilizing utility customer-funded incentives or rebates in the 2003-2012 timeframe.[3] These projects represent 61% of the total electricity savings in the public/institutional sector.

Incremental electricity savings versus savings from all projects active in a given year

We estimate both annual incremental electricity savings for ESCO projects and savings from all ESCO projects active in a given year. To illustrate our approach, Table 1 shows that projects A, B, and C produce *incremental* savings in years 1, 3, and 5 when each project installation was completed (bold figures). The *savings for projects active in year X* (in the example in Table 1, from years 1 to 12) are the sum of annual electricity savings that any *active* project is producing in a year. To determine whether a project is active or not, we calculate its useful life by using each project's mean measure lifetime[4]. We therefore estimate the persistence of first-year electricity savings over the useful life of the set of measures installed by ESCOs from the date of installation. For example, project C in Table 1 is implemented in year 5 and produces savings until year 9 because its mean measure lifetime is only 5 years. *Savings from active projects* are then estimated by summing across projects for a given year, not by summing across time for a given project or set of projects.

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[3] Given that an increasing number of states have adopted policies that support large-scale utility customer-funded efficiency, it is possible that our 10 year average may under-state the extent to which ESCOs (and their customers) utilize incentives in efficiency projects. However, we opted for a multi-year approach primarily because of sample size considerations.

[4] The mean measure lifetime corresponds to the useful life of the Energy and Environment Conservation Measure (EECM) that best characterizes the project. We group projects into one of six possible retrofit strategies depending on the EECMs implemented: lighting, minor HVAC, major HVAC, distributed generation, non-energy, and other.

Incremental savings estimates are particularly useful in states where policymakers and program administrators have established an annual efficiency savings target (e.g., an EERS) and want to assess whether that target has been met. *Savings for projects active in a given year* are a useful way of accounting for the lifetime savings contribution of ESCO projects that can potentially offset and avoid the impacts of generation options (and the associated GHG emissions) by reducing electricity usage in the long term. In short, savings for projects active in a given year reflect the annual contribution of any *active* energy efficiency project to reduce electricity consumption and associated GHG emissions.

Savings Definitions

We report two values for electricity savings:

Incremental savings are the sum of electricity savings from new projects in the year that they are installed.

Savings from active projects are the sum of the savings that any active project (i.e., a new project or an older project within its mean measure lifetime) is producing in a given year.

Table 1. Calculation example of *incremental savings* and *savings from projects active in a given year*

	Year	1	2	3	4	5	6	7	8	9	**10**	11	12
Project	A	**20**	20	20	20	20	20	20	20	20	20	-	-
	B			**20**	20	20	20	20	20	20	20	20	20
	C					**50**	50	50	50	50	-	-	-
Incremental Savings		20	0	20	0	50	0	0	0	0	0	0	0
Savings from Active Projects		20	20	40	40	90	90	90	90	90	40	20	20

Results

Incremental electricity savings

We report annual incremental electricity savings for the entire U.S. ESCO industry (Table 2); ESCO projects that are implemented by public/institutional sector customers only (Table 3); and ESCO projects in the public/institutional sector that did not utilize energy efficiency programs funded by utility customers (Table 4).

Annual incremental electricity savings for all ESCO projects range between 2 and 3 TWh in recent years, although it is worth noting that we are extrapolating savings based on a small sample size of projects from the LBNL/NAESCO database. We also report annual savings (and project cost) over a longer time period (2003-2012) for a much larger sample of projects (1,476 projects representing ~$5B in investment). Estimated annual incremental savings average about ~2.4 TWh/year for all ESCO projects (i.e., 23.7 TWh over 10 years, see Table 2).

We find that 75% of the incremental savings from new projects in the 2003–2012 period were produced in the MUSH market and 64% of those projects did not rely on incentives/rebates from utility customer-funded energy efficiency programs.

Table 2. Annual incremental electricity savings: U.S. ESCO industry

	LBNL Database				U.S. ESCO Industry
Project implementation year	# of projects	Electricity savings [GWh]	Project installation cost [million $2012]	% of U.S. ESCO industry by revenue	Estimated annual savings [TWh]
2010	139	269.6	464.5	9.1%	3.0
2011	162	246.0	624.2	11.7%	2.1
2012	147	228.4	593.8	10.0%	2.3
2003-2012	1,476	2,631.8	4,913.1	11.1%	23.7

Table 3. Annual incremental electricity savings: ESCO projects in the public/institutional market[5]

	LBNL Database			U.S. ESCO Industry	
Project implementation year	# of projects	Electricity savings [GWh]	Project installation cost [million $2012]	Market share of total U.S. ESCO market	Estimated annual savings [TWh]
2010	118	189.8	396.8	85%	2.1
2011	129	187.7	472.7	76%	1.6
2012	132	195.5	464.7	78%	2.0
2003-2012	1,181	1,979.1	3,902.5	79%	17.9

Table 4. Annual incremental electricity savings: ESCO projects in the public/institutional market that did not utilize customer-funded EE programs[6]

	LBNL Database			U.S. ESCO Industry	
Project implementation year	# of projects	Electricity savings [GWh]	Project installation cost [million $2012]	% of public/institutional market projects that did not utilize utility EE programs	U.S. ESCO industry estimated annual savings [TWh]
2010	68	118.3	249.7	58%	1.3
2011	63	69.0	168.4	49%	0.6
2012	60	86.2	208.5	45%	0.9
2003-2012	751	1,206.4	2,443.5	64%	10.9

5 We estimate the market share of ESCO projects in public/institutional market by dividing the "LBNL Database - Electricity Savings" column from Table 3 by the corresponding value in Table 2.

6 We estimate the percentage of public institutional market projects that did not utilize utility customer-funded EE programs by comparing the number of projects installed during the 2003-2012 period in Table 4 to the corresponding column in Table 3.

Electricity savings for projects active in a given year

We estimate electricity savings for projects active in a given year for the entire U.S. ESCO industry (Table 5), ESCO projects that are implemented by public/institutional sector customers only (Table 6), as well as ESCO projects in the public/institutional sector that did not utilize energy efficiency programs funded by utility customers (Table 7). Major findings include:

- About 2,000 projects in the LBNL database[7] were still actively producing savings in 2012. Extrapolating those savings to the entire ESCO industry, we estimate that U.S. ESCO projects achieved electricity savings of about 34 TWh in 2012 (see Table 5).
- Active ESCO projects targeted at public/institutional customers account for about three-quarters of the electricity savings among projects in the LBNL/NAESCO database or approximately 2.5 TWh in 2012. Extrapolating those savings to the entire industry, we estimate that active ESCO projects that target public/institutional customers achieved savings of ~24 TWh in 2012 (see Table 6).[8]
- Among public/institutional customers, ESCOs reported that about ~63% of the projects in the LBNL/NAESCO database that were still producing savings in the 2010-2012 time period did not participate in utility customer-funded energy efficiency programs (e.g., receive rebates or other financial incentives). Extrapolating these results to the entire ESCO industry, we estimate that active ESCOs projects in the public/institutional sector that did not utilize utility rebates achieved savings of about 15 TWh in 2012 (see Table 7).

Table 5. Estimated electricity savings from ESCO projects active in recent years: U.S. ESCO industry

	LBNL Database				U.S. ESCO Industry
Year	# of active projects	Electricity savings [GWh]	Project installation cost [million $2012]	% of U.S. ESCO industry	Electricity savings [TWh]
2010	1835	3,337.3	5,151.6	9.9%	33.6
2011	1919	3,426.5	5,640.9	10.2%	33.5
2012	1959	3,451.0	6,033.5	10.2%	33.7

Table 6. Estimated electricity savings from ESCO projects active in recent years: Public/institutional market

	LBNL Database			U.S. ESCO Industry	
Year	# of active projects	Electricity savings [GWh]	Project installation cost [million $2012]	Public/Institutional customer market share of total ESCO market	Savings for public/institutional market [TWh]
2010	1407	2,399.9	4,056.2	79%	24.2
2011	1482	2,466.9	4,420.8	78%	24.1
2012	1532	2,500.9	4,721.1	78%	24.4

[7] We selected a sample of projects that had reported actual and/or guaranteed electricity savings and non-zero investment costs from a total of more than 5,250 projects in the LBNL/NAESCO database. Then, our sample for this analysis is 2,547 projects.

[8] We estimate the electricity savings for projects active in a given year in the public/institutional market for the entire ESCO industry based on the ratio of savings from projects in the LBNL database (i.e., for 2012, 3,451 GWh in Table 5 and 2,501 GWh in Table 6).

Table 7. Estimated electricity savings from ESCO projects active in recent years: Public/institutional market projects that did not utilize customer-funded EE programs

	LBNL Database			U.S. ESCO Industry	
Year	# of active projects	Electricity savings [GWh]	Project installation cost [million $2012]	% of public/institutional projects that did not utilize utility EE programs	Savings for public/institutional customers that did not utilize utility EE programs [TWh]
2010	947	1,530.6	2,781.5	64%	15.4
2011	979	1,536.2	2,884.5	62%	15.0
2012	993	1,544.1	3,011.7	62%	15.0

It is important to note that financial incentives from utility efficiency programs typically account for only a small portion of total project costs in ESCO projects that target MUSH market customers. In the 1990-2012 timeframe, these incentives accounted for only 16% of total project costs for MUSH market customers (see Figure 2).

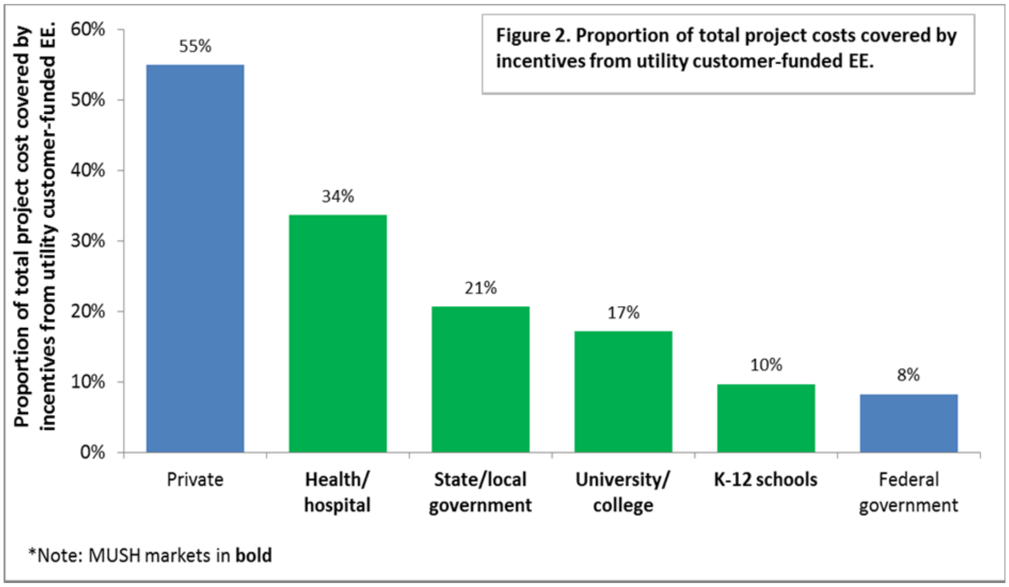

Figure 2. Proportion of total project costs covered by incentives from utility customer-funded EE.

Conclusion

We use the LBNL/NAESCO database to estimate savings for the U.S. ESCO industry in recent years. This database contains detailed project level data sent by ESCOs as part of the voluntary NAESCO accreditation process. The database currently contains over 5,200 projects—installed from 1990 to 2013—representing over $12 billion in total project investment (or ~18% of all industry activity over that time period). We estimate that active ESCO projects saved 34 TWh in 2012 or ~2.5% of U.S. commercial electricity retail sales. We find that approximately three quarters of those savings occurred at projects installed in the MUSH market (municipal, local and state government facilities, universities/colleges, K-12 schools, and healthcare facilities). We also find that about two thirds of the MUSH projects active in 2012 did not use utility customer-funded energy efficiency programs incentives. For MUSH market projects that did report using these incentives, we find that these incentives only account for 16% of total project investment costs.

Policy makers should consider expanding the use of effective strategies including energy efficiency resource standards (EERS), ESPCs for designated market segments, building energy codes, retrofit on sale ordinances, and financing—among others. In addition, policy makers should consider utilizing and/or possibly enhancing the use of energy savings performance contracts including conducting a review of (1) the type of public entities that are eligible to enter into ESPCs (e.g., local governments, school districts, higher education institutions, and other state-supported institutions), (2) expanding the length of allowable term for performance contracts, and (3) eligible technical opportunities to reduce agency expenditures (Bingaman et al. 2014). Given the large remaining market potential for the U.S. ESCO industry and recent project savings levels, we believe that there are significant untapped opportunities for the industry to develop new projects which substantially reduce future GHG emissions.

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Appendix A

Important assumptions

In interpreting our estimates of electricity savings from ESCO projects, it is important to be cognizant of several key assumptions made by LBNL in our analysis. Table A-1 summarizes these factors and their potential effect on our estimates of annual incremental electricity savings and electricity savings from ESCO projects active in a given year.

Table A-1. Key assumptions and their potential effect on electricity savings estimates

Key assumption	Effect on electricity savings estimates
We assumed that larger ESCOs provide representative sample of projects for the LBNL/NAESCO database with typical savings and costs.	In the NAESCO accreditation process, ESCOs are asked to provide a representative sample of projects (geographically and size of projects). LBNL cannot rule out the potential for selection bias. Reported savings levels for projects in the LBNL database may be higher compared to the population of all ESCO projects completed in the past 10 years.
We assumed that ESCO project savings are maintained over their useful lifetime (even after performance contract has ended).	Useful lifetime of measures installed in ESCO projects exceed the contract term in many projects (e.g., ~60% of projects in the 2003-2012 period had longer lifetimes than contract lengths). Estimates of electricity savings for projects active in a given year will be somewhat lower if savings do not continue after the contract term ends.

Key assumption	Effect on electricity savings estimates
We assumed that first-year savings from performance contracts are maintained over the contract term, because of the guaranteed savings provision within an ESPC.	Under ESPC, ESCOs are obligated to achieve guaranteed savings. Actual, reported savings often exceed guaranteed savings, but are not a contractual commitment. Estimates of electricity savings for projects active in a given year may be somewhat lower if ESCO projects only achieve guaranteed savings in later years.

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