

## **Assessing U.S. ESCO Industry Performance and Market Trends: Results from the NAESCO Database Project**

*Julie Osborn, Lawrence Berkeley National Laboratory  
Chuck Goldman, Lawrence Berkeley National Laboratory  
Nicole Hopper, Lawrence Berkeley National Laboratory  
Terry Singer, National Association of Energy Service Companies*

### **ABSTRACT**

The U.S. Energy Services Company (ESCO) industry is often cited as the most successful model for the private sector delivery of energy-efficiency services. This study documents actual performance of the ESCO industry in order to provide policymakers and investors with objective information and customers with a resource for benchmarking proposed projects relative to industry performance. We have assembled a database of nearly 1500 case studies of energy-efficiency projects – the most comprehensive data set of the U.S. ESCO industry available. These projects include \$2.55B of work completed by 51 ESCOs and span much of the history of this industry.

We estimate that the ESCO industry completed \$1.8-2.1B of projects in 2000. The industry has grown rapidly over the last decade with revenues increasing at a 24% annualized rate. We compare typical project characteristics, energy savings, and economics in institutional and private sector market segments. ESCOs typically invested about \$2.30/ft<sup>2</sup> per project in various energy efficiency improvements, although there is large variation in project costs across market segments. We find that lighting-only projects report median electricity savings of 47% of targeted equipment consumption; the median for lighting-&-non-lighting projects is 23% of the total electric bill baseline. Median simple payback time is seven years for institutional sector projects and three years in the private sector. We estimate direct economic benefits of \$1.62 billion for the 1080 projects in our database with both cost and savings data. The median benefit/cost ratio is 2.1 for 309 private sector projects and 1.6 for 771 institutional sector projects. Finally, we discuss the role of enabling legislation and policies, including ratepayer-funded energy-efficiency programs, in encouraging ESCO industry growth.

### **Introduction**

A large private sector energy-efficiency services industry has developed in North America over the last 20 years whose primary business is performance contracting. Today, over sixty national and regional Energy Services Companies (ESCOs) are actively operating in the U.S. Utilizing savings from investments in high-efficiency equipment, these companies work to provide solutions to customer needs, including facility and equipment modernization, reduced utility expenses, reliable power and improved control over facility operation and comfort.

The U.S. ESCO industry has attracted the interest of federal, state, and international policymakers interested in promoting successful models for energy efficiency. Although much has been written about the U.S. ESCO industry, few studies have relied on key

underlying empirical data – the track record of ESCOs in developing projects – in order to assess trends in ESCO market activity over time as well as actual project performance and economics from the customer’s perspective. This project, a collaborative effort of the National Association of Energy Service Companies (NAESCO), an industry trade association, and Lawrence Berkeley National Laboratory (LBNL) attempts to fill that gap by developing a large database of projects completed by ESCOs.

This database of ~1500 projects represents an investment of \$2.55B by 51 companies. Preliminary results from the LBNL/NAESCO database were first reported in Goldman et al (2000). The database has nearly doubled in size since that initial study. We have analyzed this more extensive project data and conducted a survey of active ESCOs in order to develop a comprehensive, historical “snapshot” of the ESCO industry (Goldman et al 2002). This report includes more detailed information than the initial publication on project characteristics, costs, and energy savings, as well as an analysis of project economics from the customer’s perspective and estimates of historic and current ESCO industry market activity. Overall goals of the project are to provide objective information on ESCO market and industry trends and to analyze the impact of enabling policies that facilitate broad customer access to energy-efficiency services from private sector providers.

## **Approach**

Most project information was provided by ESCOs as part of NAESCO’s voluntary accreditation process. State agencies that administer performance-contracting programs in the institutional market also submitted ~275 projects for our database. Our sample includes projects completed in 45 states between 1982 and 2001 by ESCOs for whom performance contracting is a core part of their business, although the database is not limited to performance-contracting projects. We reviewed project data and worked with individual ESCOs and state agencies to ensure data quality and accuracy. Project information provided by ESCOs has been verified through a peer review process and customer reference checks of a subset of projects. We also estimated aggregate industry size by interviewing ESCOs and industry experts to determine the portion of the industry represented by our sample.

Our database is not necessarily representative of the entire energy-efficiency services industry because of our data collection process and because ESCOs self-select projects to submit. ESCOs that want to be accredited by NAESCO submit an application every 2-3 years, which includes information on up to 50 energy-efficiency projects completed in the preceding 42-month period. The extent to which these projects represent the ESCO’s total business varies with the size of the company. For smaller ESCOs, the database typically includes all of their performance-based projects, while for larger ESCOs, the database includes a self-selected sample. Note that not all of the 1500 projects in the database have complete information in all data fields, so where appropriate we indicate sample sizes when reporting analysis results.

## **Aggregate ESCO Industry Activity**

Several previous studies have characterized the market for energy efficiency or energy services and estimated industry activity or market potential. Different sampling methods and definitions of industry scope have been used, with dramatically different results

(Cudahy and Dreessen 1996; Easton Management Consultants and Feldman 1999; Frost & Sullivan 1997). In estimating aggregate ESCO industry activity, we decided to focus on energy-efficiency and other value-added services and have excluded revenues from electric or gas commodity procurement. We collected information on market activity of 63 companies that have national or regional operations in the energy-efficiency services industry. Companies that do not offer performance contracting were excluded from our survey, although ESCOs did not have to offer performance-contracting services exclusively. We used various methods to collect this information, including interviews with NAESCO member companies (N=20) and financial information on individual ESCOs from state agency program RFQs (N=17). We also surveyed several industry experts through a modified delphi approach in order to develop high and low estimates of historic and current market activity of 26 other companies that were identified as ESCOs.

### **Industry Revenues Reached ~\$2Billion/year in 2000**

**Figure 1** shows our low and high estimates of ESCO industry activity between 1990 and 2000. We estimate that ESCO market activity for various energy-efficiency related services ranges between \$1.8B and \$2.1B in 2000. The industry has experienced rapid growth during the last decade with aggregate revenues increasing at a 24% annualized rate. Growth has slowed since 1996, with 9% annualized revenue growth over the period 1996-2000. Factors that may explain slower growth rates include the relative maturity and saturation of performance contracting in the institutional market, the upheaval and uncertainties created by electricity restructuring and retail competition in various states, reduced spending on ratepayer-funded energy-efficiency programs, and competition from new entrants such as retail energy service companies. We estimate that 13 companies with annual revenues over \$30 million (M) account for ~75% of total industry activity.

In our high estimate, performance contracting as a fraction of these 63 companies' total activity has dropped from 74% (1995 and earlier) to 57% (1996-2000). The size of the performance-contracting market ranges between \$0.9B and \$1.2B in 2000. These results suggest that performance contracting may not be the primary source of future growth for the ESCO industry, but rather that revenue growth may hinge on successful development of energy-efficiency related value-added services that build on ESCO core competencies.

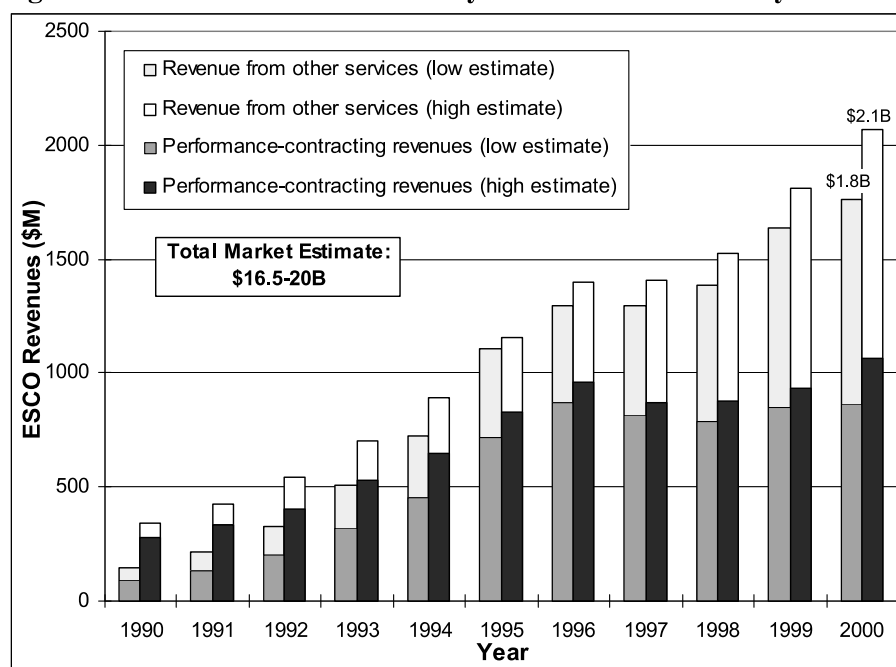
We believe that the \$2.55B in investment represented by the ~1500 projects in our database represents about 15% of total ESCO industry activity during the 1990-2000 period. From 1990 to 1995, our database projects represent about \$400M (11%) of the \$3.0-4.1B total cumulative ESCO industry investment during this time period. From 1996-2000, the \$1.6B of project investment in the database represents about 19% of the \$7.9-8.7B invested in ESCO projects during that period.

### **Typical Project Characteristics**

ESCOs are active in almost all states, although this activity is concentrated in areas with high population and economic activity, and states with attractive performance-contracting legislation, supporting policies or public benefits funding for energy efficiency (Kushler & Witte 2001). In our sample, four states (New York, New Jersey, California and Texas) account for 44% of market activity. **Figure 2** shows the range of project costs for

1420 projects representing an aggregate investment of ~\$2.55B. Projects completed since 1996 account for about two-thirds of reported costs. This skew reflects both our intensified data collection efforts and the growth of the ESCO industry in recent years. Median and average project costs are \$0.7M and \$1.8M respectively over the entire sample, although projects vary tremendously in size. The range in project investment is quite large, even among projects in the same market segment.

**Figure 1. Estimated Market Activity of U.S. ESCO Industry**

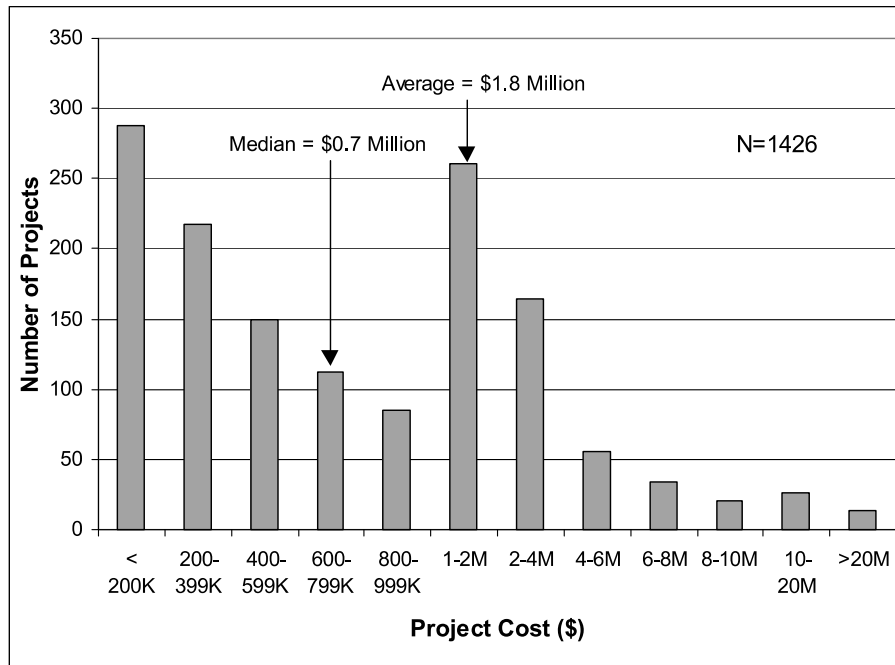


### ESCOs Focus on Institutional Sector Customers

ESCOs classified their projects using market segment categories that we created (see **Table 1**). In much of our analysis, we examine trends between institutional and private sectors, rather than individual market segments. We find that this distinction impacts project performance and economics because of differences in customer motivation, access to capital, and planning time horizons.

Approximately 73% of the projects in our database are from the institutional sector. The total share of private sector projects represented in the database dropped from 33% before 1996 to 25% from 1996 on. We believe that the institutional market share in our database represents an upper bound on ESCO activity in this market for two reasons. First, ESCOs are more reluctant to divulge information on private sector projects. Second, our sample also includes ~275 projects that were provided voluntarily by eight state agencies that administer performance-contracting programs.

**Figure 2. Range in ESCO Project Costs**



**Table 1. Market Segments in Institutional and Private Sectors**

Institutional Sector	Private Sector
K-12 schools	Hotels/hospitality
State/local government	Office, commercial
University/colleges	Retail
Federal government	Industrial
Health/hospitals	Residential
Public housing	Other

### Multiple Measures, Multiple End Uses

Projects typically install multiple measures or retrofits that target several end uses. Individual energy conservation measures were aggregated into 11 broader “measure categories” for analysis purposes. Penetration rates of measure categories for database projects are: lighting measures (82%), comfort conditioning (68%), motors/drives (23%), water heaters (8%), power supply (6%), refrigeration (2%), miscellaneous equipment/systems (3%), industrial process improvements (3%), other measures/strategies (21%), plumbing products & fittings (10%), and non-energy improvements (3%)<sup>1</sup>. Comfort conditioning measures are more popular in institutional projects than in private sector

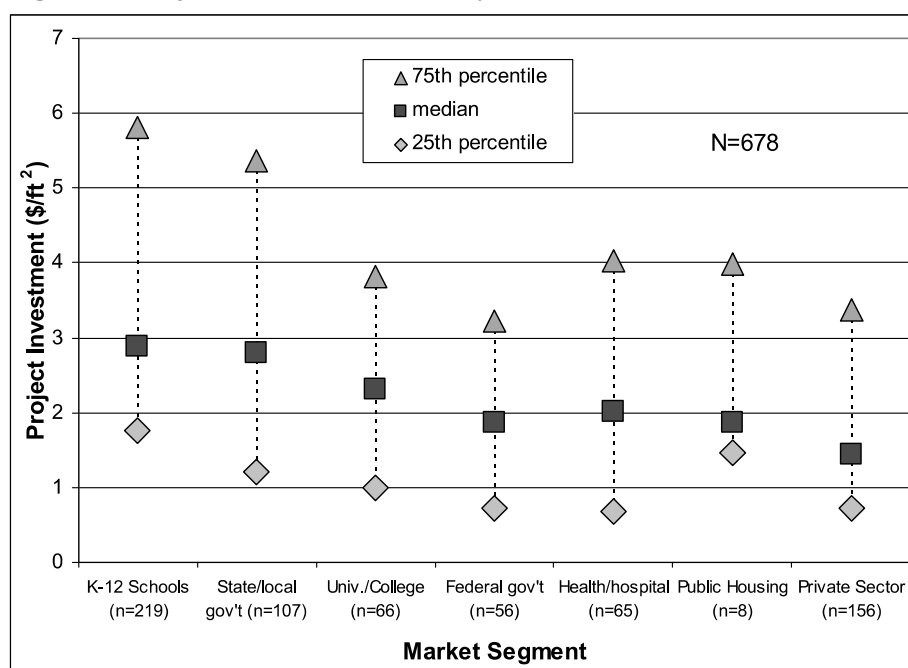
<sup>1</sup> ESCOs reported installing non-energy improvements almost exclusively in the institutional sector, often in K-12 Schools. Roof replacement/repair was the most common type of non-energy improvement, followed by asbestos abatement and new ceilings.

projects (76% vs. 45%). Our data suggest that institutional sector projects, on average, target a greater number of measure categories than projects for private sector customers.

### Project Investment is Higher in Institutional Markets

In aggregate, median project investments in the institutional sector are three times higher than in private sector projects (\$0.9M vs. \$0.3M). This relationship holds true when normalized for floor area, as shown in **Figure 3**. Median project costs/ft<sup>2</sup> are 1.8 times greater in institutional than in private sector projects (\$2.50/ft<sup>2</sup> vs. \$1.40/ft<sup>2</sup>). The difference in the number of retrofit measure categories between market sectors may help to explain this trend. There is large variation in costs among projects in the same sector but for all projects, the median investment is \$2.3/ft<sup>2</sup>.

**Figure 3. Project Cost Normalized by Floor Area**



### Performance-Contracting Market Share Is Decreasing among ESCOs

Over the last decade, there has been an evolution in the types of contractual agreements utilized by ESCOs and their clients. ESCOs were asked to characterize the type of contract agreement for each project as guaranteed savings, shared savings, pay-from-savings, asset ownership/chauffage, design/build, fee-for-service or fixed price. The share of performance-contracting projects in our sample has decreased significantly since 1996 (from 92% before 1996 to 76% since). This trend likely understates the shift away from performance-contracting arrangements in the energy efficiency services market overall because of our data collection approach and focus. Guaranteed savings contracts and design/build or fee-for-service arrangements are the most common contracting approaches. The 621 projects that employed performance contracting had higher project investment than

the 160 projects that used non-performance contracts (\$1.0M vs. \$0.5M). Of the performance-based contracts in our database, 86% used the guaranteed savings contracting mechanism. Typical duration of contracts in our sample is 10 years, although shorter term contracts (i.e., <5 years) have become increasingly popular since 1995 (~20% of projects during this time period). Contracts lasting more than 15 years accounted for about 10% of projects in the database.

## Delivered Energy Savings

We also analyzed typical project energy savings. ESCOs were requested to report baseline consumption as well as predicted and actual (verified) savings in energy and/or dollar terms for each project. Reductions in **electricity** consumption are critically important to project success, accounting on average for over 80% of total energy savings (on a site energy basis). Median energy savings (electricity and other fuels) are 15 kBTU/ft<sup>2</sup> for the 29% of projects that provided sufficient data to complete this analysis. Median energy savings (electricity and other fuels) are higher for state/local government and health/hospital projects (18-19 kBTU/ft<sup>2</sup>) compared to 13-15 kBTU/ft<sup>2</sup> for K-12 schools, university/college, federal government and private sector projects. Reported project energy savings vary widely. After normalizing for floor area, energy savings typically vary by a factor of 3-5 for the middle 50% of projects within each market segment (inter-quartile range).

## Percent Electricity Savings

We grouped projects into three retrofit strategies in analyzing percent savings: lighting-only (LO), lighting-&-non-lighting (LNL), and non-lighting-only (NLO) measures. The baseline metric used to gauge pre-retrofit electricity consumption differs by retrofit strategy. Baseline electricity consumption for LO projects is usually measured for the targeted equipment only; LNL project electricity consumption tends to be measured on a total facility (utility bill) basis.

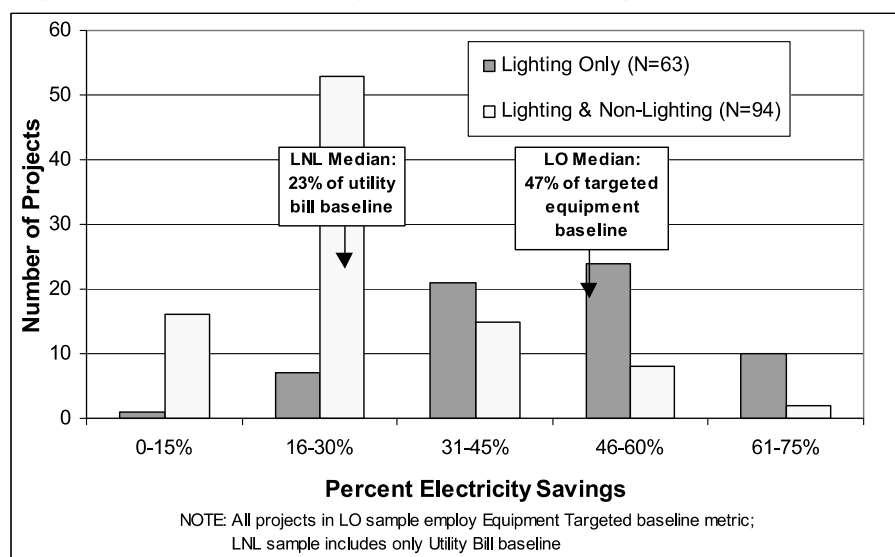
**Figure 4** shows the distribution in percent electricity savings for projects using these two retrofit strategies. LO projects report median electricity savings of 47% of the targeted equipment (with inter-quartile range of 37% to 56%). These results suggest that ESCOs are achieving significant reductions in lighting energy consumption. The median electricity savings for the 94 LNL projects is 23% of the total electric bill baseline with an inter-quartile range of 17% to 32%. These results give a sense of the extent to which ESCO projects are impacting total facility electricity usage.

## Project Economics from the Customer's Perspective

For each project in the database, we calculated three economic indicators: net benefits, benefit/cost (B/C) ratio, and simple payback time (SPT). We chose to define economic benefits conservatively and included only the direct value of reduced expenditures on energy and other financial savings, such as operations and maintenance (O&M). ESCO projects may also yield a number of indirect or less tangible benefits such as increased productivity, replacement of aging equipment, improved amenity and comfort levels, and environmental improvements. For many customers, these benefits are as important and

valuable as cost savings from direct energy-related expenditures. Because it is difficult to assign a dollar value to indirect benefits, our analysis focused only on the dollar value of the direct economic benefits of ESCO projects. Thus our approach is likely to underestimate the actual value of these projects to customers.

**Figure 4. Electricity Savings by Retrofit Strategy**



Based on customer market research and discussions with ESCOs, institutional sector customers typically have longer planning horizons, can access third party financing at attractive interest rates, and issue solicitations for performance contracts that allow for relatively long economic payback times (e.g., 10-25 years). In contrast, in evaluating energy-efficiency project proposals, private sector customers often have high investment hurdle rates (which translate into shorter payback periods), shorter planning horizons (e.g., due to leased space), and often face higher interest rates for third party financing (e.g., due to risk of plant shutdown, business risks). To reflect these differences, we used lower nominal discount rates in our economic analysis of institutional sector projects (7% with 10% sensitivity analysis) than for private sector projects (10% and 15%).

### Project Net Benefits

For the 1080 projects with both cost and savings data (73% of the database), net direct economic benefits are ~\$1.62B, using 7% and 10% nominal discount rates respectively for institutional and private sector projects (see **Tables 2** and **3**). Net benefits for the entire sample decrease to \$874M at the higher discount rates of 10% and 15% respectively. About 90% of the gross benefits come from energy savings, with the remaining 10% attributed to non-energy (e.g., O&M) savings.



## Cost-Effectiveness of ESCO Projects

We found that 87% of the 309 private sector projects and 70% of the 771 institutional sector projects have B/C ratios greater than one. The B/C ratio is 1.6 for institutional sector projects using a 7% discount rate and 1.3 using a 10% discount rate (see Table 1). For private sector projects, the median B/C ratio ranges between 2.1 and 1.6, depending on the choice of discount rates (see Table 2). We believe that these results may understate the value of projects to customers, because we have not accounted for indirect benefits and have used conservative assumptions (i.e., discount rates).

**Table 2. Institutional Sector Project Economics: Benefit/Cost Analysis**

Market Segment	N	Total Project Costs (\$M)	7% Discount Rate						10% Discount Rate					
			Direct Economic Benefits (\$M)		Benefit/Cost Ratio				Direct Economic Benefits (\$M)		Benefit/Cost Ratio			
			Gross	Net	25 val	median	75 val	Gross	Net	25 val	median	75 val		
K-12 schools	289	714	803	88	0.7	1.0	1.7	633	-81	0.5	0.8	1.3		
State/ local gov't	159	276	581	305	1.0	1.7	3.0	471	195	0.9	1.4	2.4		
Univ./ colleges	100	301	809	508	1.2	1.7	3.1	637	336	0.9	1.4	2.4		
Federal gov't	58	153	280	126	0.9	1.7	3.2	225	72	0.8	1.4	2.6		
Health/ hospital	134	136	365	229	1.6	2.3	3.8	295	159	1.3	1.9	3.3		
Public Housing	31	96	140	45	0.7	1.5	1.8	114	18	0.6	1.2	1.4		
Institutional Sector	771	1677	2978	1301	0.9	1.6	2.5	2375	698	0.7	1.3	2.0		

**Table 3. Private Sector Project Economics: Benefit/Cost Analysis**

Market Segment	N	Total Project Costs (\$M)	10% Discount Rate						15% Discount Rate					
			Direct Economic Benefits (\$M)		Benefit/Cost Ratio				Direct Economic Benefits (\$M)		Benefit/Cost Ratio			
			Gross	Net	25 val	median	75 val	Gross	Net	25 val	median	75 val		
Commercial*	192	137	349	212	1.7	2.2	3.7	265	128	1.3	1.7	2.8		
Industrial	76	95	181	86	1.3	1.8	2.7	136	41	1.0	1.4	2.2		
Other**	41	28	47	18	0.8	1.8	2.7	34	6	0.7	1.3	2.0		
Private sector	309	260	576	317	1.4	2.1	3.2	435	176	1.1	1.6	2.6		

\*includes hotels/hospitality, retail space, and commercial offices.

\*\*includes residential and projects that were classified as "other" by the ESCO.

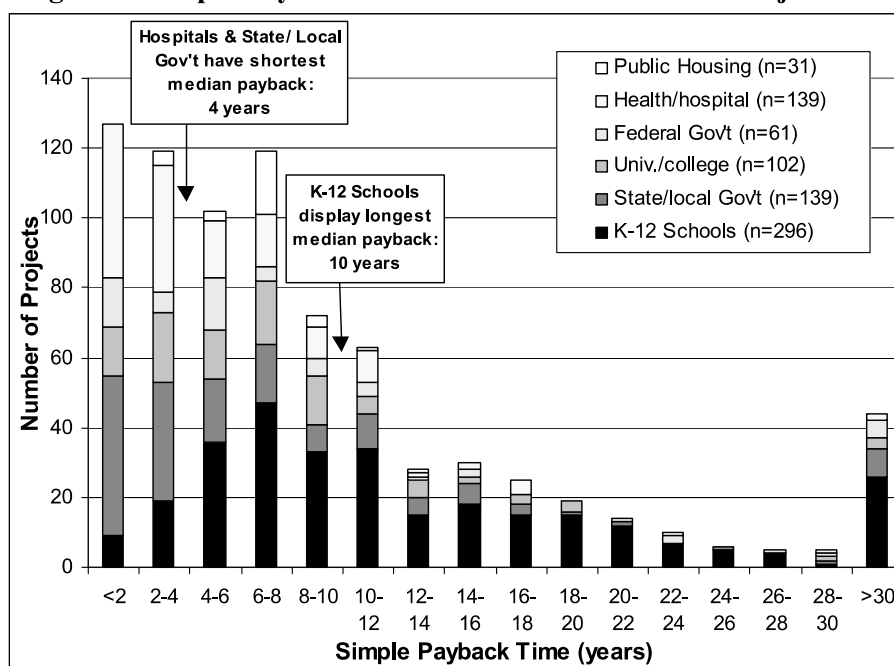
## Simple Payback Time (SPT)

We calculated SPT for each project by dividing project costs by savings<sup>2</sup>. Savings were determined by multiplying average annual energy savings by the appropriate price for that energy source (e.g., electricity, gas) in the year the project was completed. If actual energy savings were not available, we used the dollar value of savings as reported by the ESCO. The median SPT is about seven years for the 788 projects in the institutional sector (see **Figure 5**). Approximately 44% of institutional sector projects have a SPT of six years or less. Within the institutional market, median payback times are shorter (4 years) in the 139 health/hospital and 159 state/local government projects compared to the 296 K-12 schools projects with a median payback time of 10 years. In contrast, median SPT is about three years for the 319 private sector projects; about 83% of these projects have a SPT of six years or less.

<sup>2</sup> For projects that received a rebate, we subtracted 100% of the incentive from project cost; for other REEP programs, we subtracted 50% of the reported incentives from project cost; other projects were unaffected.

Our analysis suggests that project economics are also influenced by choice of retrofit strategy and state or federal performance-contracting guidelines (e.g., maximum contract terms). We compared SPT in institutional and private sectors for projects grouped by retrofit strategy (see **Table 4**). First, note the higher share of LO projects in the private sector than the institutional market (43% vs. 20%). Second, median payback times for LO projects are relatively short in both institutional and private sector projects (2 years). Third, median payback times are significantly longer for LNL and NLO projects in the institutional sector than the private sector projects (8 vs. 4 and 2 years). As these retrofit strategy categories are quite broad, it appears that private sector projects selectively focus on individual measures with shorter payback times. This result is not surprising given the typical time horizon for decision-making in the private sector.

**Figure 5. Simple Payback Time of Institutional Sector Projects**



**Table 4. Impact of Retrofit Strategy on Simple Payback Time**

Retrofit Strategy	Simple Payback Time (years)							
	Institutional Sector				Private Sector			
	N	25 val	median	75 val	N	25 val	median	75 val
Lighting Only	146	1	2	4	128	1	2	4
Lighting & Non-Lighting	498	5	8	13	97	3	4	6
Non-Lighting Only	98	2	8	14	73	1	2	5

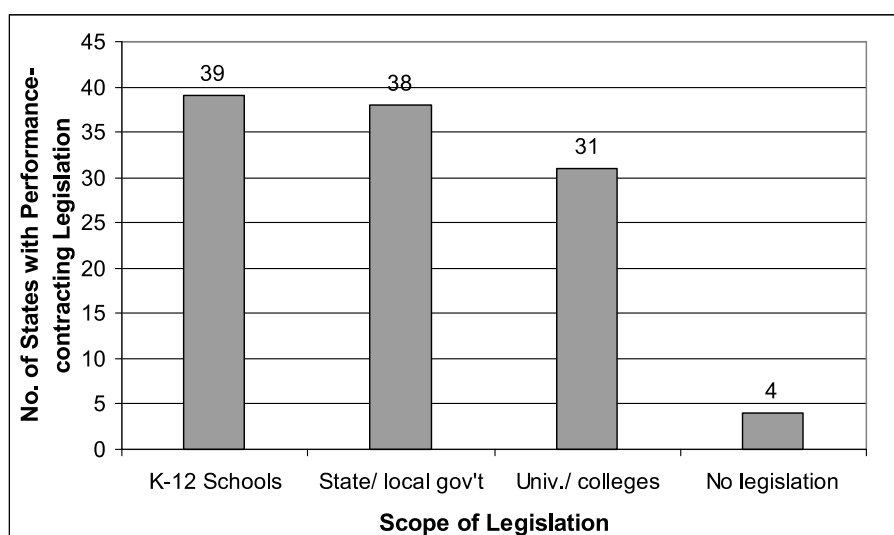
In the institutional market, enabling legislation and program guidelines influence project economics and the types of measures installed in projects. For example, many states specify the maximum contract term for performance contracts in their enabling legislation. The underlying intent of these provisions is to articulate the state's willingness to undertake comprehensive projects that install and finance high-efficiency equipment and other

measures up to a cost-effectiveness threshold. More than two-thirds of U.S. states (34) allow maximum contract terms of 10 or more years. Thus it is not surprising that energy-efficiency equipment and measures that are installed in institutional sector projects have long expected economic lifetimes and SPTs.

## The Role of Enabling Policies and Programs

Policies and programs supported by state or federal legislatures and public utility commissions (e.g., energy efficiency programs) have played an important role in stimulating ESCO activity in various markets. In a survey of state legislation, we found that most states allow or encourage performance-contracting projects in various public institutional markets: K-12 schools, state/local governments, and university/colleges (**Figure 6**). Only four states have no such legislation in any of these market segments.

**Figure 6. Most States Promote Performance Contracting with Legislation**



## Drivers of Performance Contracting in Institutional Markets

Our sample of institutional sector projects suggests that the amount of performance-contracting activity in K-12 school, university/colleges, and state/local government market segments is affected by a state's overall potential market size, favorable enabling legislation and procurement rules for performance contracting, and active support from state energy program offices. **Table 5** shows the 10 states with the highest levels of ESCO institutional project investment in our database. We ranked each state in terms of their economic activity (gross state product), state energy office activity,<sup>3</sup> number of institutional sectors targeted by

<sup>3</sup> We surveyed several industry experts and asked them to categorize the activity level of state energy offices or the office responsible for administering performance-contracting programs in the institutional market. Activity level was ranked on a scale of 1 to 3 (3 = high activity and 1 = low activity).

enabling legislation, and overall performance contracting promotional rating based on a simple metric developed by LBNL.<sup>4</sup>

Eight of the top 10 states in terms of ESCO institutional project investment also ranked in the top 10 for economic activity. This result underscores the reality that ESCOs tend to be most active in states with large markets. Favorable performance-contracting legislation may have the most impact in states with medium to smaller size institutional markets that might not otherwise attract ESCO interest (e.g., Indiana). For example, Kentucky, Missouri and Washington have enabling legislation that covers all three institutional markets and these states report high numbers of projects in our database, with total project costs that place them in the second activity tier (rank 11-20). Ohio is the only state in the top 10 with enabling legislation in only one market segment (K-12 schools). Other enabling policies such as REEPs may also play a role. For example, four of the top five states in terms of ESCO institutional project investment had REEPs that were particularly attractive to ESCOs (e.g., SPC programs in New York, New Jersey, California and Texas).

**Table 5. State ESCO Promotion and Activity Ranking**

State	ESCO Project Costs (SC, UC & GO) <sup>†</sup>			Economic Activity (1999 GSP)*		State Energy Office Activity 1=low, 2=medium, 3=high**	Number of Sectors with Legislation	LBNL Overall Rating*** of State Support for Perf. Contracting
	Rank <sup>†</sup>	(\$M)	N	Rank <sup>†</sup>	(\$B)			
New York	1	287	76	2	755	2.3	3	7
California	2	147	81	1	1229	1.0	3	3
Texas	3	131	40	3	687	2.0	3	6
Indiana	4	112	23	15	182	1.0	3	3
New Jersey	5	84	95	8	332	2.0	3	6
Illinois	6	75	38	4	446	2.0	3	6
Ohio	7	68	45	7	362	2.0	1	2
Massachusetts	8	66	27	11	263	1.7	3	5
Florida	9	65	23	5	443	1.0	3	3
Pennsylvania	10	54	37	6	383	2.0	3	6

<sup>†</sup>SC = K-12 schools, UC = university/colleges, GO = state/local gov't

<sup>†</sup>Ranking among the 50 U.S. states; 1=highest, 50=lowest.

Sources:

\* Bureau of Economic Analysis 2001

\*\* Values are averages of responses in a blind survey of several industry experts

\*\*\* Calculated as "State Energy Office Activity" level multiplied by the "Number of Sectors with Legislation"

## Conclusion

This report summarizes industry and market trends in the energy-efficiency services industry based on a bottom-up analysis of ~1500 projects. We have tried to demonstrate the value of compiling and analyzing project-specific information on the ESCO industry using standardized methods in order to provide useful information to policymakers and market actors alike. In undertaking such an effort, we are cognizant of limitations imposed by our

<sup>4</sup> We combined the activity of state energy offices and the number of institutional sectors covered by enabling legislation into a single metric (calculated as "State Energy Office Activity" level multiplied by the "Number of Sectors with Legislation").

data collection methods (e.g., project selection bias), inconsistent ESCO tracking and reporting practices of ESCOs, and uneven quality of project data. We have adopted various quality assurance measures and controls to improve data quality and consistency and reached out to other data sources (e.g., state energy offices) to minimize self-selection bias.

The NAESCO/LBNL database project is an ongoing initiative, which provides a unique information source on industry trends, market activity and business practices of companies involved in energy-efficiency related services. We intend to continue to expand and refine the project database and industry/market analysis reports in order to continue to address evolving information needs of policymakers, market actors, and customers.

## **Acknowledgements**

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