Combining Energy Efficiency Building Retrofits and Onsite Generation: An Emerging Business Model from the ESCO Industry

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ABSTRACT

The U.S. energy service company (ESCO) industry is an example of a private-sector business model where energy efficiency savings are delivered to customers primarily through the use of performance-based contracts. Despite the onset of a severe economic recession, we estimate that the U.S. ESCO industry grew about 7% per year from 2006 to 2008 with annual revenues of about $4.1 billion in 2008. About 75% of industry revenues are directly related to the installation of energy efficiency measures at existing buildings in the institutional, commercial, and industrial sectors.

The ESCO business model in the United States continues to evolve with ESCOs undertaking more complex and comprehensive projects that involve combining numerous energy efficiency measures with onsite generation. This paper draws upon an ESCO industry survey conducted in 2009/2010 as well as results from the Lawrence Berkeley National Laboratory (LBNL)/National Association of ESCOs (NAESCO) database of projects. The survey results indicate that U.S. ESCO industry revenue related to installations of onsite generation increased 40% from 2006 to 2008. We also analyze typical project-level savings and installation costs. This paper focuses on comprehensive ESCO projects in various target markets that installed both onsite generation and energy efficiency measures. We discuss factors that may contribute to the increased deployment of renewable energy and onsite generation technologies including the possibility that ESCOs are leveraging publicly-funded incentives and government tax credits for renewable energy projects.

Introduction

A significant ramp-up in energy efficiency activities is occurring at the local, state, and federal level. These activities include the establishment - in 26 states - of statewide energy savings goals as directed by Energy Efficiency Resource Standards (EERS), legislative or state regulatory directives to obtain all cost-effective demand-side resources, and a significant increase in federal funding for energy efficiency programs (e.g., American Recovery and Reinvestment Act (ARRA)). As part of this increased focus on energy efficiency, policymakers are evaluating the role of private sector companies, including Energy Service Companies (ESCOs), in delivering cost-effective energy savings to end-users.

The U.S. ESCO industry provides energy savings to customers primarily through performance-based contracting. This private industry, developed over the past 30 years, has largely been a successful model for the efficient, cost-effective delivery of energy-efficient technologies and services to public/institutional and private sectors of the economy. A recent industry survey and analysis of project-level results confirms that ESCOs are evolving away from simple lighting-only retrofits and into more complex (and capital-intensive) building

retrofits. This evolution towards comprehensive projects has important implications for the long-run financial performance of projects, especially from the customer's perspective.

We report results from a survey of ESCO industry executives performed in 2009/2010 and use the results from this survey to estimate the current and projected size of the ESCO industry, by total revenues. The survey also asked several questions about other market activity and perceived trends in project installation costs, savings, and economics. This paper also discusses results from the Lawrence Berkeley National Laboratory (LBNL)/National Association of ESCOs (NAESCO) database of ESCO projects. We identify typical project costs, savings, and economic performance from the customer's perspective for comprehensive ESCO projects. We conclude with key findings.

Definition and Size of the U.S. ESCO Industry

The U.S. ESCO industry has been active for more than 30 years installing energy conservation projects in both the public and private sector across all geographic regions. In this paper, we 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.*

This definition is in line with the European Commission Directive (2006/32/EC) on Energy End-use Efficiency and Energy Services (ESD) 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). While ESCOs perform work in most states, there are several states and regions with conditions more amenable for business development and new project implementation. These factors may include: market potential of targeted sectors, favorable state policies[1] (e.g., enabling legislation that allows or encourages performance contracting in various institutional markets, ratepayer-funded energy-efficiency programs), level of economic activity, condition of the existing stock of buildings, population density, and actual and/or projected energy prices.

Historically, ESCOs have primarily pursued energy efficiency improvements in existing buildings.[2] Among non-residential customers, ESCOs have had most success in developing projects in public and institutional markets—federal, state and local government facilities,

[1] Bharvirkar et al. (2005) studied the magnitude of energy efficiency activity in the state government market and found that performance contracting activity was a strong predictor of ESCO investment activity. They found that Pennsylvania, Maryland, Massachusetts Missouri, Kansas, and Texas had the highest levels of performance contracting investment in the state government sector since 2000.

[2] ESCOs have not had much success getting developers or owners to enter into performance contracts in the new construction market for a variety of reasons. For example, it is more challenging to establish "baseline" energy usage levels in new construction against which to compare savings and harder to establish occupancy levels and schedule in a new building. Despite these difficulties, some of the larger ESCOs have started to respond to developers' interest in green buildings and are offering various energy-related services that support green building certification processes.

schools, universities/colleges and hospitals. Customers in the institutional sector tend to manage their own facilities, are often subject to aggressive legislative or executive energy savings mandates and see, in the absence of capital budget appropriations, long-term performance contracts as a way of paying for a share of major capital improvements out of project savings.[3] ESCOs are also active in the commercial and industrial sectors, but have had more limited success in penetrating these markets. Relatively few ESCOs operate in the residential market; those ESCOs that are active in this market typically target larger multi-family and public housing facilities. Other types of energy service providers, including equipment and controls manufacturers, engineering and construction firms, various types of contractors (heating and air conditioning, controls, windows, lighting, and insulation specialists), and energy consulting firms also provide efficiency services to residential, commercial and industrial customers.

Survey of U.S. ESCO Industry Executives

Survey Methods

We conducted interviews with U.S. ESCO industry executives between October 2009 and February 2010. Respondents were asked to provide information on their annual revenues from energy services in 2008, projected growth in annual revenues from 2008 to 2011, activity in various market segments, types of contractual arrangements, revenues from various types of activity (e.g., energy efficiency retrofits, onsite generation, consulting), and their views on industry trends (e.g., increasing installation costs over time).

We developed a comprehensive list of firms that were either self-identified ESCOs or were on qualified lists of energy service providers established by select public sector agencies, drawing from the following sources:

- ESCO members of NAESCO[4];
- Department of Energy (DOE) list of qualified Energy Service Performance Contractors[5]; and
- Qualified ESCOs for performance contracting programs in state facilities (Pennsylvania, Virginia, Montana, Colorado, Wisconsin and Florida).

Through this process, we identified an initial target list of 109 companies, compared to the 63 companies identified in Hopper et al. (2007). This list was reduced further by eliminating companies that were either not ESCOs per our definition or were not currently offering performance contracting as a service.[6] We attempted to contact senior executives at each company that would be knowledgeable about their company's revenues and market activity, and would also have the authority to release the requested information.

Our estimated response rate was 55% among active ESCOs (29 out of 53). We then estimated annual revenues for 15 of the remaining ESCO non-respondents using a Delphi

[3] See Hopper et al. (2005) for a discussion of the context, motivations for, and barriers to performance contracting in public and institutional markets.
[4] Available at: http://www.naesco.org/organizations/companies.aspx?CatID=3.
[5] Available at: http://www1.eere.energy.gov/femp/pdfs/doe_ql.pdf.
[6] See Satchwell et al. (2010) for a detailed discussion of the methodology in developing the target list of companies.

approach similar to the approach reported in Hopper et al. (2007).[7] *Accordingly, our estimates of aggregate revenues for the ESCO industry are based on a sample of 44 companies*. We believe our combined survey and Delphi revenue estimates provide information on nearly all ESCOs that are actively operating in the United States.

In estimating the size of the ESCO industry, we do not include companies such as engineering and architectural firms, HVAC, lighting, windows or insulation contractors, 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 do not include companies that only provide onsite 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.

Estimates of Current and Projected ESCO Industry Size

We asked ESCO respondents to report their revenues from energy services[8] in 2008, average annual growth rates since 2007 and projected growth in revenues for the 2009-2011 period. Aggregate revenues for the ESCO industry are estimated at about $4.1 billion in 2008 (see Figure 1).[9] Hopper et al. (2007) estimated that ESCO industry revenues were $3.6 billion in 2006. Thus, our analysis suggests that ESCO revenues have increased about 7% per year since 2006.[10]

We developed an aggregate estimate of projected industry revenues through 2011 by using individual ESCOs' projections for revenue growth which were applied to their 2008 revenues. We project that the ESCO industry in aggregate will have annual revenues of $7.1–7.3 billion in 2011; this represents an average annual growth rate of 26% per year for the 2009-2011 period. ESCOs are quite optimistic about their business prospects over the next 2-3 years, and they clearly hope to capitalize on energy efficiency programs funded by the ARRA. For example, about 51% of the $3 billion for the State Energy Program block grants is targeted at

[7] A Delphi technique is a process used in business forecasting of reaching a consensus by the anonymous solicitation and comparison of the views of experts (e.g., see Linstone and Turoff, 1975). The non-respondent companies were typically smaller ESCOs and represent only about 4% of the total ESCO market as a share of 2008 industry revenues (based on our estimates). We also examined the reasonableness of market revenues reported by ESCO respondents and the range of revenues for non-respondents through the Delphi technique. We compared estimated revenues for individual companies with historic data provided by ESCOs as part of the Hopper et al (2007) study as well as other recent public information (e.g., company websites, U.S. Securities and Exchange Commission filings, press releases). As a result of this process, we adjusted revenue estimates for a few non-respondent ESCOs.

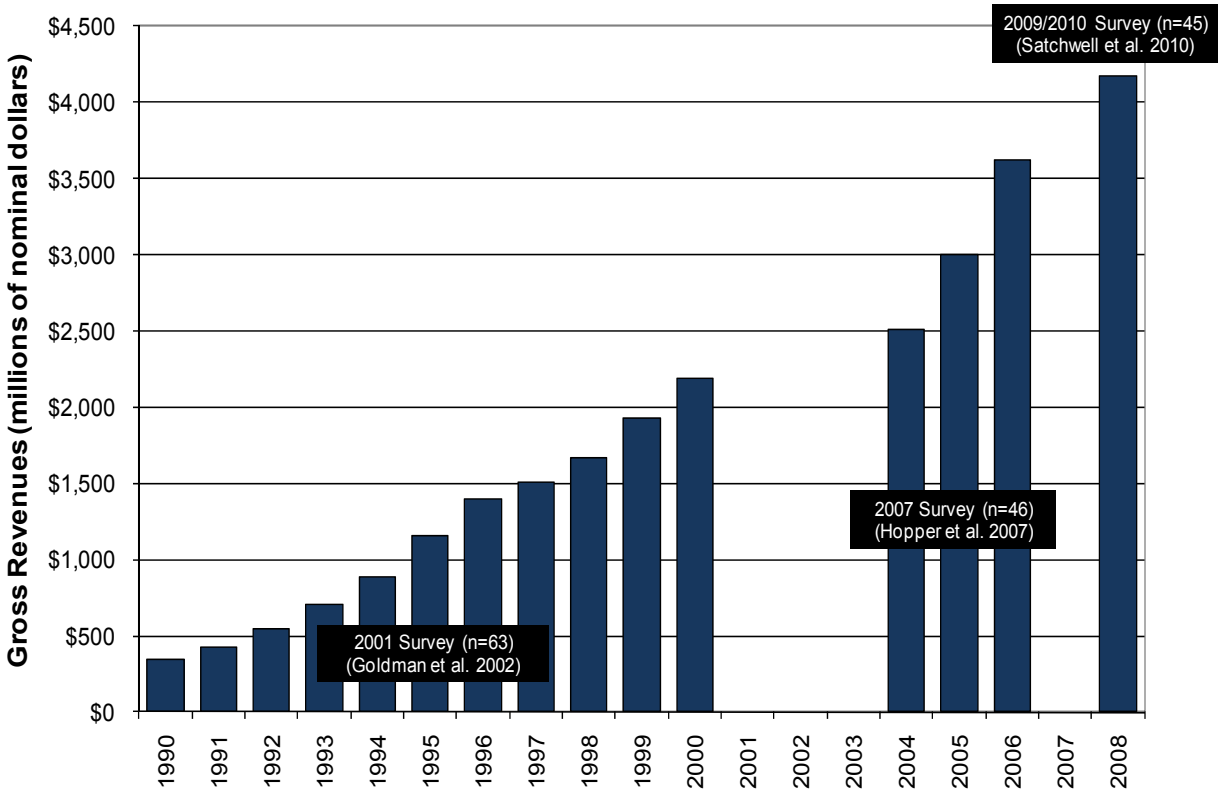
[8] We defined energy services to include projects such as performance contracts, design/build projects, engineering, procurement & construction services (EPCS) projects, and consulting that involved energy efficiency or other energy-related services, including onsite generation projects for end users. We specifically asked companies to *exclude* revenues from retail commodity sales or projects built to supply power to wholesale markets.

[9] Hopper et al. (2007) projected 2008 revenues of $5.2 to $5.5 billion compared to actual 2008 revenues of $4.1 billion. This gap in projected and actual revenues is likely due to several factors, including: (1) an unexpected downturn in the U.S. economy, (2) ESCOs' projected activity level in private sector markets did not materialize, (3) tightening of customer credit markets, (4) slower than expected acceleration of the federal ESPC market, (5) industry consolidation, and (6) overly optimistic projections being provided by our survey respondents. See Satchwell et al. (2010) for a detailed discussion.

[10] The NAESCO/LBNL surveys conducted in 2001, 2007, and 2009 did not ask for reported revenues in the years 2001-2003 and 2007.

building retrofits primarily in public sector markets that have historically been receptive to ESCOs and performance contracts (Roehrig 2010). Some ESCOs also expect that the significant ramp-up in ratepayer-funded energy efficiency and renewable programs will improve the economics of projects for targeted customers (Barbose et al. 2009).

Figure 1. Aggregate ESCO Industry Revenue from 1990 to 2008



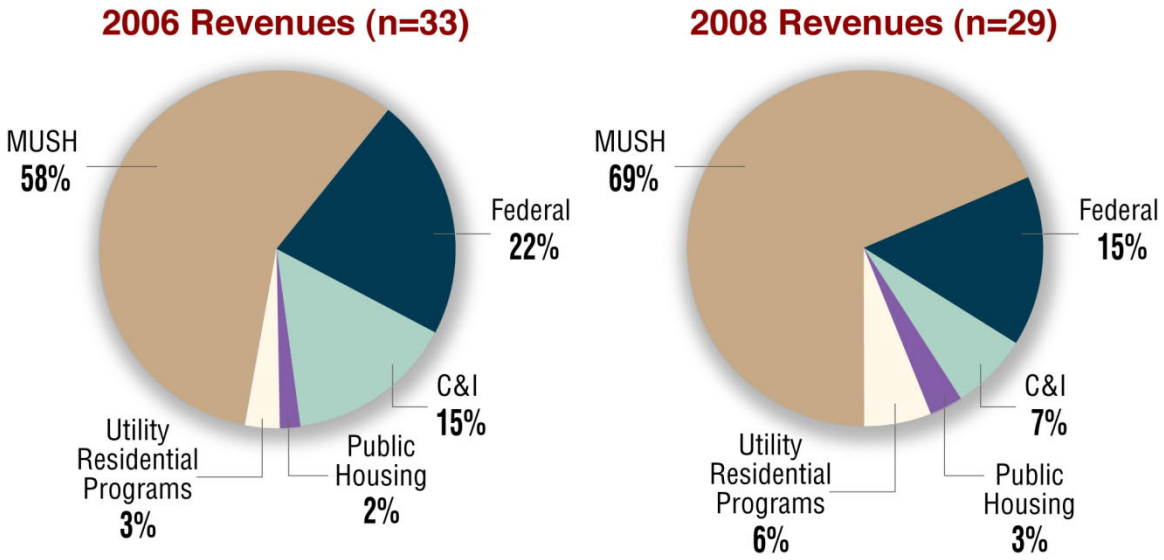
ESCO Activity by Market Segment and Type of Project

We asked ESCO respondents to report 2008 actual revenues by market segments, project and technology strategies, and contractual arrangements. We compared the responses to similar breakdowns in 2006 industry revenues in Hopper et al. (2007) to identify trends in the ESCO industry. The "MUSH" markets—municipal and state governments, universities and colleges, K-12 schools, and hospitals—have historically hosted the largest share of U.S. ESCO projects. The MUSH markets account for $2.8 billion in ESCO revenues in 2008or about 69% of total industry activity (see Figure 2). The MUSH market share of total ESCO revenues has increased over 10% since 2006.[11] ESCOs have been active in the MUSH market for almost two decades and it is a mature market for ESCOs. However, the remaining market potential for energy efficiency is quite large in the MUSH market. A scoping analysis conducted by LBNL indicated that remaining energy efficiency opportunities in larger facilities in the MUSH market could

[11] Larsen et al. (forthcoming) also reports a significant increase in ESCO project data in the K-12 schools market in recent years, which is consistent with self-reports by ESCOs of their activity by market segment.

produce annual energy savings of 160 million MMBtu, lifetime savings of 2.4 billion MMBtu and require about $35 billion in additional ESCO investment.[12]

Figure 2. 2006 and 2008 ESCO Industry Revenues by Market Segment



ESCO activity in the federal market appears to account for a somewhat lower share of total industry revenues in 2008 compared to 2006 (22% vs. 15%). ESCOs provide energy services to federal agencies through several contractual mechanisms, including Energy Savings Performance Contracts (ESPC), as implementers of Utility Energy Service Contracts (UESC) and as contractors for projects that rely on direct appropriations. We know from other public sources that ESCO market activity in the federal market increased significantly in FY09 and FY10 as DOE reported $440M in project investment in FY09 and $498M in FY10.This increase in federal market activity is due in part to the extension of previous DOE Super-ESPC contracts; so the declining market share from 2006 to 2008 may be a temporary phenomenon. Over the long run, the federal market is likely to be an important market for ESCOs because of mandates from the federal government to reduce the energy intensity of federal buildings and establish greenhouse gas (GHG) emissions reduction goals. For example, the Energy Independence and Security Act of 2007 (EISA, 2007) established an energy reduction goal for federal buildings of 30% by 2015 and the Obama Administration issued an Executive Order setting a 28% reduction in federal GHG emission levels by 2020 (Executive Order No. 13514, 2009).

The commercial and industrial (C&I) sector accounted for about 7% of ESCO industry revenues in 2008, declining from a 15% market share in 2006. ESCO revenues in 2008 from commercial/industrial projects was about $300 million, which is lower than 2006 revenues reported by ESCOs for this private sector market (~$540M). The traditional ESCO business

[12] LBNL assumed that ESCOs would target facilities greater than 50,000 square feet (which accounts for about 65% of the floor area; that ESCOs had achieved ~40-45% market penetration in the MUSH market based on survey responses, and that ESCOs could achieve savings and cost per square foot levels that were comparable to completed projects in the ESCO database.

model based on long-term performance contracts has always been a tough sell to private sector customers who typically prefer shorter project payback times.

In the industrial sector, many customers are reluctant to enter into long-term contracts, because they are not sure how long the manufacturing plants will remain open or at what operational level. Also, measurement and verification (M&V) of savings tends to be more challenging for industrial process retrofits, which may involve technologies that are proprietary or commercially sensitive, as a result of which outside parties on site are not typically welcome.

In the private commercial building sector, most building owners are looking for a short-term increase in net operating income (NOI), which leads them to emphasize low-cost/no-cost operating improvements or short payback retrofits (*e.g.,* retro-commissioning or common area lighting) rather than the comprehensive retrofit projects that ESCOs deliver. Also, during the period covered by the survey, the commercial building market has been in a severe downturn, making it difficult for building owners to finance comprehensive energy efficiency retrofits at attractive interest rates.

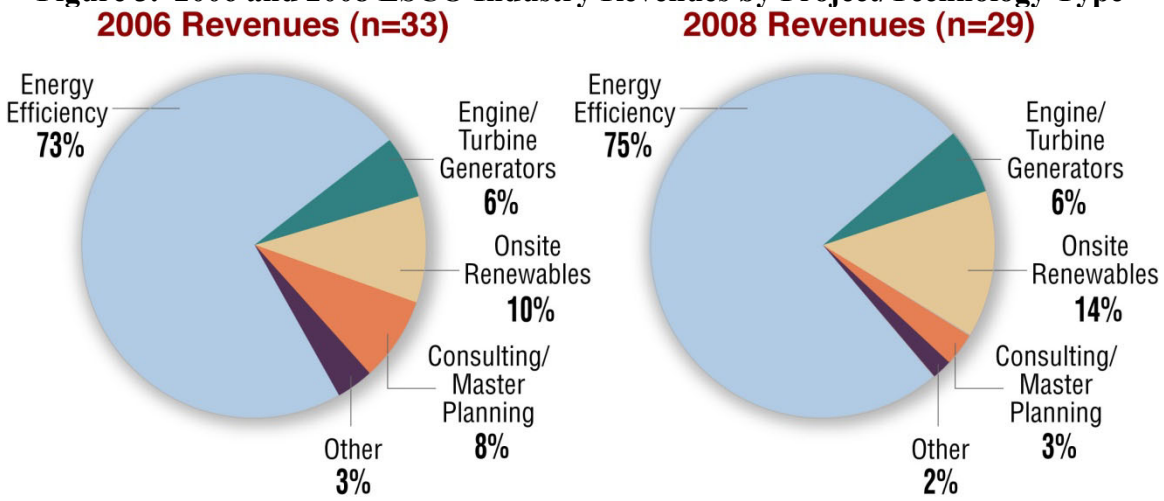
However, it is worth noting that ESCOs retain a stronger presence in industrial and commercial markets in Asian and European markets (Vine, 2005; Murakoshi and Nakagami, 2009).[13]

We also asked respondents to report their 2008 revenues among various project and technology strategies (see Figure 3). ESCOs reported that energy efficiency technologies represent a major share of industry activity, accounting for 75% of ESCO industry revenues or about $3.0 billion per year in 2008. The share of ESCO revenues from energy efficiency has increased slightly since 2006 (73% was reported by Hopper et al. in 2007).

Onsite renewable generation accounts for 14% of ESCO industry revenues in 2008 ($570 million), compared to 10% of ESCO industry revenues in Hopper et al. (2007). Factors that may contribute to the increased deployment of renewable energy and onsite generation technologies are that ESCOs are leveraging publicly-funded incentives and bundling renewable energy with energy efficiency improvements to help customers meet various goals (*e.g.,* energy independence, environmental footprint reductions).

[13] Murakoshi and Nakagami (2009) reported the industrial sector had a 46% share of FY 2007 Japanese ESCO industry revenues (~$162 M out of ~$353 M) from projects that include performance contracts, Energy Service Providers (ESP), or on-site generation.

Figure 3. 2006 and 2008 ESCO Industry Revenues by Project/Technology Type



Analysis of LBNL/NAESCO Project Database

The LBNL/NAESCO database, the most comprehensive database of project information in the world (~3,250 ESCO projects), is used to identify typical project investment levels, savings, and economic performance from the customer's perspective.

LBNL has collected important information about performance-based projects from various sources for more than fifteen years. Most project data is provided by individual ESCOs as part of NAESCO's voluntary accreditation process (87% of database or about 2,800 projects).

A number of state agencies that administer and oversee performance contracting programs also provided information on projects completed by ESCOs. State agencies from Florida, Hawaii, Kentucky, Illinois, New York, Pennsylvania, Michigan, Washington, Kansas, California, Maryland, and Missouri provided information on 271 completed projects (~8% of the database projects) after being contacted by LBNL.

We also obtained project information for projects completed as part of the Department of Energy's (DOE) Energy Savings Performance Contract program (i.e. DOE Super-ESPC), which account for ~5% of the project database.

Installed Energy Conservation Measures

ESCOs install a wide range of energy conservation measures (ECMs) that provide energy and cost savings, improved system reliability, and non-energy or indirect benefits (e.g., worker productivity gains). The range of measures installed in the federal, MUSH, and private sector projects in the LBNL database is shown in Figure 4, along with measure saturation (i.e., percent of projects that installed a particular ECM).[14]

The key technologies in public and private sector markets are lighting (66%-80% of projects) and HVAC controls (~25%-63% of projects). The prevalence of these measures is explained by their low installation costs and high savings – the resulting short payback times

[14] See Larsen et al. (forthcoming) for details of the individual measures included in the measure categories.

make them attractive investments as stand-alone projects, but also as a means to leverage longer-payback measures to achieve comprehensive projects within a customer's payback criteria.

Several measure categories exhibit statistical difference[15] among the federal, MUSH, and private market sectors at a 99% confidence level, including lighting, boilers, chillers, controls, distribution/ventilation equipment/systems, building envelope, water heating measures, high-efficiency refrigeration, industrial process improvements, behavioral and operational strategies, and customer distribution system equipment. The statistical significance informs that the results show different costs and market structures among the market sectors. For example, non-energy improvements and water conservation measures exhibit a statistical difference at the 95% confidence level; these projects differ in terms of cost to install and are also different in terms of the needs of customers they address. In addition there is a higher market penetration for capital intensive measures (e.g., boilers, chillers, distribution systems) in the public sector.

There are also several examples of emerging measures in ESCO projects that have been included since Hopper et al. (2005), but have low measure saturation rates. About 1% of the projects in the database (44 projects) reported installing load management systems, although more recently, there is increased interest among customers looking to utilize automated peak-saving technologies and potentially leverage regional electricity market revenues. About 3-4% of the projects report installing various types of distributed generation (e.g., renewables, cogeneration). Behavioral and operational strategies (e.g., rate analysis, staff training, and commissioning) are relatively popular measures with saturations that range between 12% and 18% in the private sector and MUSH market respectively. These measures are typically part of comprehensive projects and illustrate the ability of some ESCOs to include these types of measures as part of a performance contract.

An analysis of primary retrofit strategies over time in private sector projects reveals several interesting trends (see Figure 5).[16] First, lighting-only retrofits accounted for 33% of all private sector ESCO projects in the 2005-2008 period, a significant decrease from the 1990-97 period, in which 53% of ESCO projects in private sector were lighting-only retrofits[17]. Second, ESCOs are installing more onsite generation with onsite generation measures accounting for 24% of private sector projects for the 2005-2008 period.

[15] We do not assume the distributions of ESCO projects in the database fit a normal distribution for the population of all ESCO projects and report all statistics in terms of the population of ESCO projects in the database only. In this section, we apply a Kruskal-Wallis one-way analysis of variance, which is a non-parametric method using rank order for more than two categories. We assume the binomial distributions of saturation of each measure category to be statistically different at the p=0.01 or p=0.05 level as our alternative hypothesis. For the specific procedure in SAS, see Narayanan and Watts (1996).

[16] To examine project trends according to the technical aspects of projects, we grouped the 200+ ECMs into six major retrofit strategies that characterize projects according to the key technologies installed. We developed an approach that assigns a single, primary retrofit strategy to each project based on the majority of ECMs that fall into each retrofit strategy category taking into account the cost of each ECM (see Larsen et al. (forthcoming) for a detailed discussion of our approach to classify energy conservation measures into a primary project retrofit strategy).

[17] We grouped completed projects into three distinct time periods: (1) 1990-1997, (2) 1998-2004, and (3) 2005-2008. Larsen et al. (forthcoming) discusses the context for each time period.

Figure 4. Saturation of Installed Measures at ESCO Projects

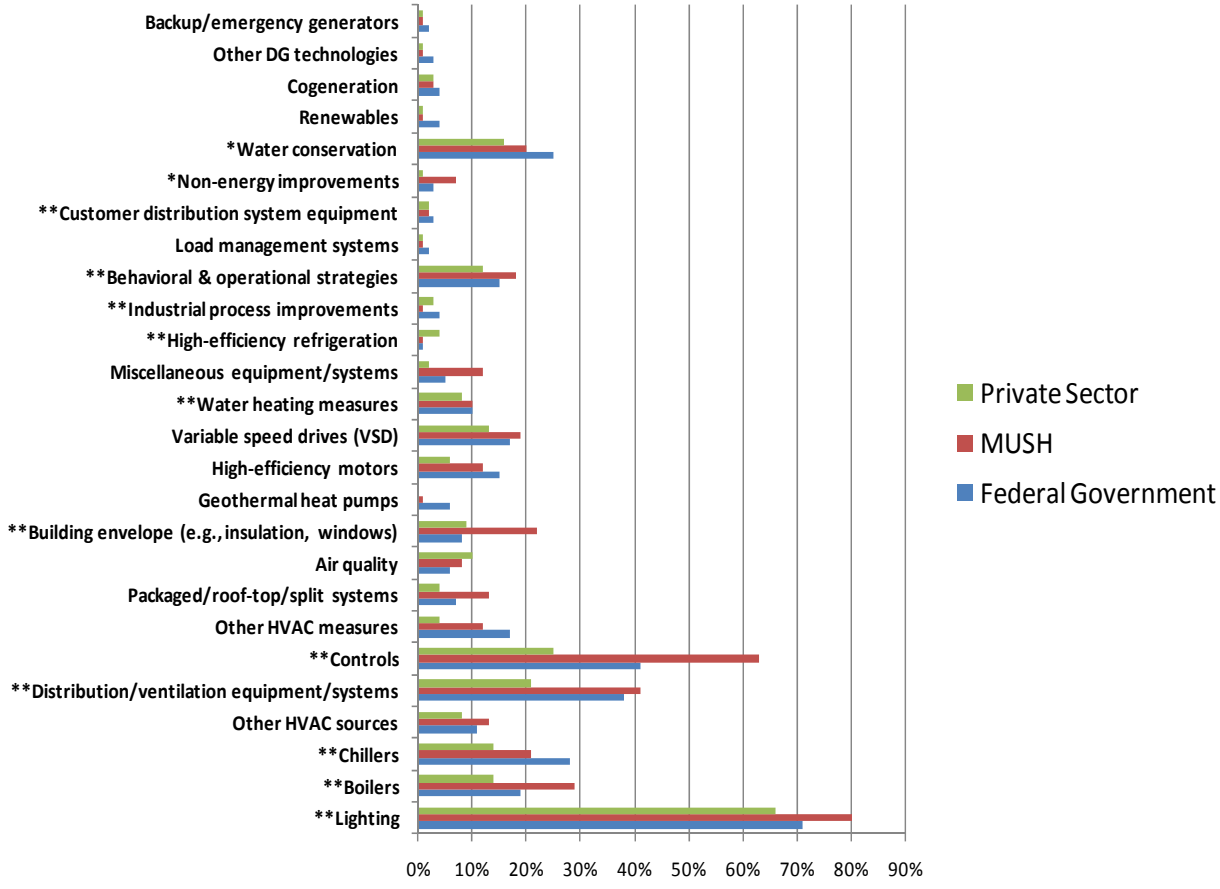
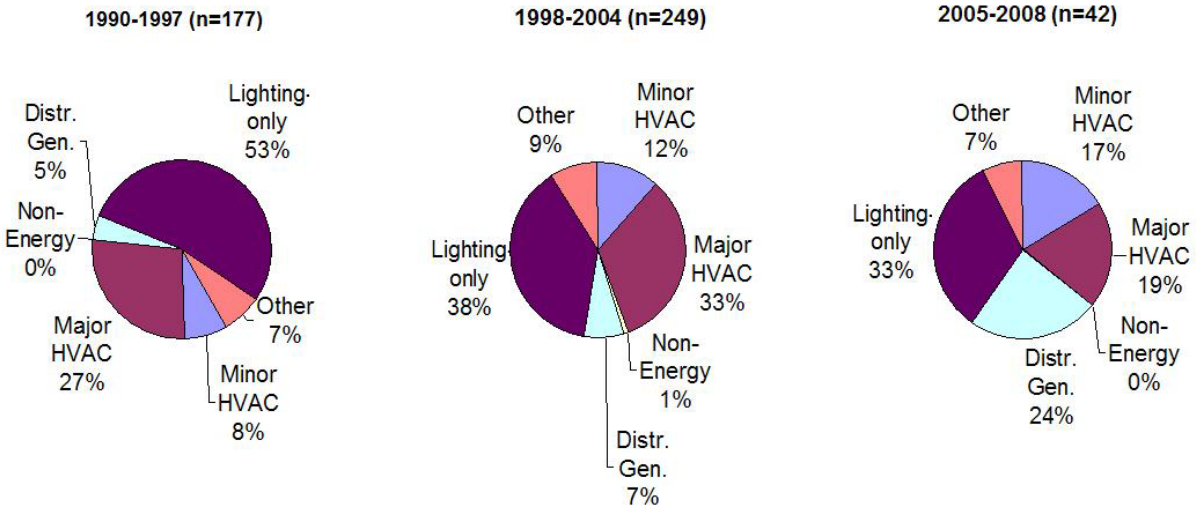
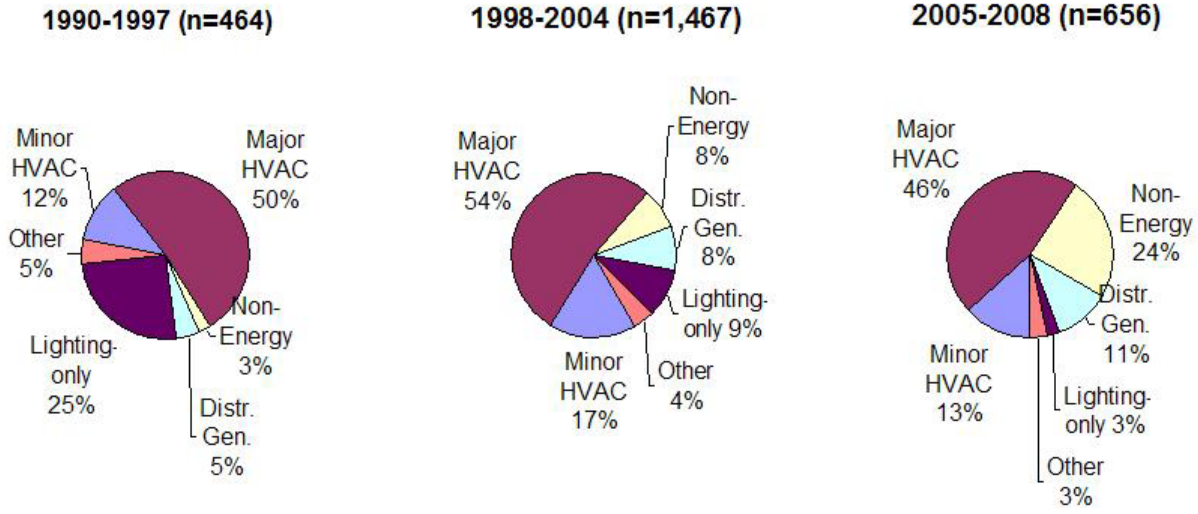


Figure 5. Percentage Share of Retrofit Strategies in the Private Sector: 1990-2008



A different picture emerges in the public /institutional sector where major HVAC has remained the dominant retrofit strategy since the early 1990s (46% to 54% of public sector projects were major HVAC retrofits; see Figure 6). Lighting-only projects have decreased from 25% of public and institutional sector projects in the 1990-1997 period to only 3% in the 2005-2008 period. Onsite generation projects account for an increasing share of ESCO projects in the public sector (5% in 1990-97 to 11% in 2005-2008). Overall, our results suggest that differences in retrofit strategies in public and private sector projects have persisted over time.

Figure 6. Percentage Share of Retrofit Strategies in the Public and Institutional Sector: 1990-2008



Project Investment and Savings Levels

We also found that project investment levels (i.e., customer installation costs without long-term financing charges) were also increasing for four of the six primary retrofit strategies (see Table 1). Strategies that are primarily focused on lighting-only, non-energy, major HVAC, and minor HVAC retrofits are exhibiting installation cost increases over time even after accounting for the effect of inflation. Onsite generation and other retrofit strategies typically had slightly decreased investment levels over time. As mentioned earlier, we reported that major HVAC and lighting retrofit strategies were the most common strategies reported by the ESCOs. This finding suggests that the project investment level increases in those primary retrofit strategies may be significantly influencing the broader increase in project investment levels in both the public and institutional and private sectors discussed above.

Table 1. Median Project Investment Level Intensity by Major Retrofit Strategy

		Median Project Investment per Square Foot ($2009/ft^2)		
Retrofit Strategy	**n**	**1990-1997**	**1998-2004**	**2005-2008**
Lighting-only	260	$1.4	$1.3	$1.6
Major HVAC	1095	$3.4	$4.5	$5.8
Minor HVAC	346	$2.3	$3.1	$4.4
Non-Energy	253	$2.9	$6.9	$10.5
Onsite Generation	165	$7.7	$5.9	$6.8
Other	87	$4.3	$1.8	$1.9

Non-energy retrofits ($0.53 annual savings/ft^2) and onsite generation projects ($0.52 annual savings/ft^2) typically exhibit the most dollar savings per square footage of floor area. These retrofit strategies are more capital-intensive and are generally replacing older equipment generating larger savings than other less capital-intensive retrofit strategies. Table 2 details annual dollar energy savings per square by primary retrofit strategy over time.[18]

Table 2. Median Project Annual Savings by Major Retrofit Strategy

		Median Project Annual Savings per Square Foot ($2009/ft^2)		
Retrofit Strategy	**n**	**1990-1997**	**1998-2004**	**2005-2008**
Lighting-only	455	$0.31	$0.38	$0.42
Major HVAC	1197	$0.49	$0.49	$0.51
Minor HVAC	389	$0.33	$0.38	$0.41
Non-Energy	247	$0.25	$0.58	$0.56
Onsite Generation	154	$0.64	$0.47	$0.61
Other	202	$0.35	$0.34	$1.04

[18] ESCOs use a number of methods to estimate savings of energy conservation measures installed at a typical project site relative to baseline usage. For some projects, including lighting-only installations, ESCOs reported baseline consumption only for the lighting equipment to be replaced. In more comprehensive projects, ESCOs typically estimate baseline consumption using total facility energy consumption from an analysis of customer utility bills.

Key Findings

It was first noted by Hopper et al. (2005) that the industry was going through a transition from simple lighting-only projects to installing much more comprehensive and capital intensive retrofit strategies, including HVAC equipment replacements and on-site generation. Our analysis of trends in ESCO industry revenues and project data confirms that the ESCO industry is evolving by installing more comprehensive retrofit strategies. The market share of revenues for onsite/renewable generation was 14% of 2008 revenues ($570 million), which is an increase from 10% of ESCO industry revenues in 2006 ($360 million). It appears that ESCOs and their customers are leveraging incentives offered by public benefit funds, government tax credits, and bundling onsite generation with energy efficiency improvements in order to enhance the overall economic attractiveness of these projects. We expect that ESCOs will continue to deliver more comprehensive services to customers in the near future, driven in part by ratepayer-funded energy efficiency programs that encourage comprehensive retrofits in all end uses and government initiatives that support deployment of renewable energy projects.

Based on our analysis of ESCO projects in the database, there has been a gradual increase in the number of distributed/onsite generation, minor HVAC, and other primary retrofit strategies, with a significant decrease in lighting-only projects since 1990. The capital equipment needed for more comprehensive retrofits tends to be more expensive to install relative to the installation costs for lighting-only projects. There is evidence that an increasing prevalence of capital-intensive retrofit strategies, like on-site generation, may be a key driver in explaining the increasing project investment levels being reported at ESCO projects. And, this trend is not particular to the U.S. ESCO market. In Japan, Murakoshi and Nakagami (2009) found that per-contract investment levels were also increasing due in part to trends related to project diversification, onsite generation, and a general move towards larger scale EE projects. Policymakers interested in encouraging private-sector energy efficiency investments should consider this trend towards comprehensive retrofit strategies.

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