CERC-BEE Task F2

Energy Service Companies in the Building Sector
--- A Review of International and Chinese Experience

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June 2013

Acknowledgement

This report was sponsored by the U.S.-China Clean Energy Research Center's Building Energy Efficiency Program funded by the United States Department of Energy. The Natural Resources Defense Council (NRDC) also provided co-funding for this work.

The authors are especially thankful to the following colleagues for their support and insightful suggestions and comments: David Goldstein (NRDC), Xiang Liu (Nexant), Zhiming Pan (NRDC), Laurie Kerr (NRDC), Barbara Finamore (NRDC), Nan Zhou (LBNL), Mark Lavine (LBNL), and Adam Hinge (Sustainable Energy Partnerships). Our appreciations also go to Jack Marzulli, Yaling Wang, and Menghan Wang of NRDC for their translation and editorial assistance.

Disclaimer

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Acronyms

ARRA	The American Recovery and Reinvestment Act
BEE	Building Energy Efficiency
BOOT	Build Own Operate and Transfer
CERC	U.S.-China Clean Energy Research Center
CHP	Combined Heat and Power
EERS	Energy-Efficiency Resource Standards
EPC	Energy Performance Contracting
ESCO	Energy Service Company
ESPCs	Energy savings performance contracts
EU	European Union
HVAC	Heating, Ventilation, and Air Conditioning
IPMVP	International Performance Measurement Verification Protocol
kWh	kilowatt hours
M&V	Measurement and Verification
MOF	Ministry of Finance (of China)
MUSH	Municipal, (State and Federal governments), Universities, Schools, and Hospitals
NDRC	National Development and Reform Commission (of China)
PPP	Public Private Partnership
REEPs	Ratepayer-funded Energy Efficiency Programs
RMB	Chinese currency name
SAVE	Specific Actions for Vigorous Energy Efficiency (European Commission's program)
SPE	special purpose enterprise
tce	metric ton of coal equivalent
THERMIE	The European Commission's Program for the research, development, demonstration and promotion of non-nuclear energy technologies
TWh	Terawatt hours

Executive Summary

Since the oil crisis of the 1970s, a business model known as energy service company (ESCO) or energy performance contracting (EPC) has been practiced in many countries to help identify and realize opportunities in energy conservation and energy efficiency. ESCOs have met with varying degrees of success in different countries and sectors, indicating the existence of important barriers to its wider application. To shed some lights on what the future may hold for the ESCO industry, this report reviews the current status of ESCOs in the United States, China, the European Union, and Japan, including the characteristics, business models, the supporting policies, and the main barriers to their further development.

ESCO Types

In the United States, building equipment manufacturers have the biggest share of the ESCO market. In 2008, their share of revenue was 49 percent, while independent ESCOs had 22 percent. However, in terms of company size, the ESCO industry has been dominated by big ones, with twelve companies accounted for 88 percent of the industry's activities in 2008.

In China, the first three ESCOs were set up in 1997 with support from a World Bank's multi-year energy efficiency program. As of 2012, China had 4,175 companies engaged in EPC. Most of the existing ESCOs are small- and medium-sized in terms of revenue, with less than 3 percent of them realized RMB 100 million (≈US$15 million) or more in 2010.

In the European Union, the number of ESCO companies is estimated at between 650 and 1,040 based on a survey of 27 EU member states carried out in 2009-2010. Germany, Italy and France have larger number of ESCOs. ESCOs in the EU are dominated by international manufactures of building automation and control systems.

In Japan, the number of ESCO companies had grown from eight in early 2000 to 104 registered by 2012. Most companies are a division of large utility, construction, engineering and building system and electric equipment companies.

Business Models

ESCOs generally fall into one of the two types of contracting arrangements: performance-based and non-performance based. “Shared savings” and “guaranteed savings” are the two main performance-based models.

The shared savings concept is an ideal introductory model in developing markets, but in the long term this model will hinder competition between ESCOs and banks.

In the U.S., shared savings has become much less common than guaranteed savings since early 2000. The public sector is more in favor of guaranteed savings contracting than the private sector. According to the U.S. ESCOs database established by the Lawrence Berkeley National Lab, 67 percent of public sector projects used guaranteed savings, while only 32 percent of the private sector projects used it.

Similarly, in China there have been more ESCO projects based on guaranteed savings than based on shared savings. The former accounted for 57 percent of the ESCO market share and the latter 32 percent during the 11th Five-Year Plan period (2006-2010). The Chauffage type – a form of non-performance based financing arrangement -- takes about 8 percent and other types take the remaining 3 percent of the market. China’s current policies specifically support this business model. In the U.S., many large ESCO projects are of guaranteed savings type, because unlike in the shared savings model, the guaranteed savings type involves a third-party financing institution, which directly faces users.

In the non-performance based group, the Chauffage model is widely used, which typically involves a long term contract and calculating the payment for energy efficiency services based on the customer’s existing energy bill. Large energy supply companies tend to use this model. Chauffage is the most popular type of contracting in the EU, accounting for 80 percent of all contracts and enjoys dominance in France, Italy and Spain and is also popular in Germany and the U.K.

In strong contrast to the U.S. and the EU, the ESCO market in Japan had been dominated by guaranteed savings contracting since the inception of ESCOs in 1998. However, this situation has been changing since 2002 and shared savings model reached 53 percent of the market share by 2007, while guaranteed savings reached a record low of only 10 percent.

ESCO Markets

The revenue of U.S. ESCO industry was US$1.8-2.1 billion in 2000 and grew to $7.1-7.3 billion in 2011 (estimate). In terms of market share of different customer categories, the public and institutional sector, which typically include municipal, state and federal governments, universities and colleges, K-12 schools, and hospitals -- the so-called "MUSH" market, has continued to dominate the ESCO market.

China has witnessed a similar rapid growth trend. In the 11th Five-Year Plan period (2006-2010), the revenues realized by the ESCO industry grew 16 times, from 4.73 billion RMB (≈ US$0.7 billion) to 83.629 billion RMB (≈ $1.3 billion). In terms of investment levels, industrial facilities have been the largest customers group for ESCOs in China, accounted for 71.7 percent of the total ESCO-related investments during 2006-2010. However, in terms of the number of projects, the building sector comes first.

In the EU, France and Germany have the largest and second largest ESCO markets, with France's revenue reaching €4-5 billion and Germany's between €1.7-2.4 billion in 2009. Although the ESCO industries in 27 EU countries are at different stage of development, there is one commonality that is so are the public sector has been their major customer.

Japan's ESCO market revenue reached a record high of US$353 million in 2007; however, this amount was calculated on a broader scope that included energy performance contracts, energy service providers, and on-site generation projects. Due to stringent government procurement laws and regulations, the public sector in Japan has never been able to tap into energy-efficiency services offered by ESCOs. As a result, the industrial sector and commercial sector have been the only two types of customers driving the ESCO market.

Efficiency Measures of ESCO Projects

In the U.S., major HVAC measures (heating, ventilation, and air conditioning equipment) have consistently accounted for near or over half of the retrofit measures used by ESCOs for their public sector customers. However, for their private sector customers, ESCOs had done more lighting efficiency than HVAC work. In 2005-2008, major HVAC work accounted for only 17 percent of the energy efficiency measures for all private sector projects, while lighting-only strategy's share reached to 53 percent during that period.

No specific data has been found on the shares of different efficiency measures implemented by ESCOs in China. A few articles brief mention that the majority of China's energy performance contracts have dealt with HVAC, lighting, motor, and waste heat recovery.

In the EU, public lighting, HVAC, control system renovation are common in ESCO projects, but Combined Heat & Power (CHP) continues to play a major role as well. Deep retrofit such as building insulation is less common.

Measurement and Verification

As energy efficiency projects have become more complex, developing and adopting a standardized protocol for measuring and verifying energy-savings has become increasingly important for performance-based contracting.

A survey of U.S. ESCO market from 1990-2008 found that total facility energy consumption was the prevailing metrics (54 percent) used to measure and verify both energy and cost savings in public sector, while equipment level metrics (61 percent) was most favored by the private sector.

The Chinese government issued *General Technical Rules for Measurement and Verification of Energy Savings* (GB/T 28750-2012) in 2012, which define the principles and rules of delineating project boundaries and calculating energy savings. Since these M&V rules were released only recently, a 2011 study found that most ESCO projects had not adequately planned M&V before the energy conservation measures are implemented.

A lack of standardized M&V has been widely cited across most of the EU countries as an important barrier to the growth of energy performance contracting model and the ESCO industry. The International Performance Measurement Verification Protocol (IPMVP) presents common terminology and defines full disclosure to support rational discussion of often contentious M&V issues. But it is a high level framework without specifying project design.

Enabling Policies

In the U.S., five major federal and state-level policies and programs have had direct impacts on the development of U.S. ESCO industry and the market, including 1) Ratepayer-funded Energy-Efficiency Program; 2) Energy Savings Initiatives for Buildings; 3) Energy Efficiency Resource Standards; 4) Energy Savings Performance Contracts; and 5) American Recovery and Reinvestment Act.

The Chinese government has issued 29 policies since 2000 that have relevance to ESCOs. These policy documents can be grouped into seven types of different purposes: 1) providing financial support; 2) offering tax benefits; 3) improving accounting regulations; 4) enhancing financing services; 5) encouraging ESCO development; 6) encouraging ESCOs to form alliances and exercise self-discipline; and 7) building a supportive environment for the ESCO industry. While these policies cover rather comprehensively, they are all general. Only the first two types of policies have had additional implementation procedures issued.

In the EU, several favorable legislative provisions and financial incentives have driven the development of ESCOs, including performance standards for new buildings, subsidies available for private homeowners of renovating their houses, and fiscal mechanisms. The liberalization of the gas and electricity markets and higher electricity prices has also helped ESCOs.

Similarly in Japan, the main factors for ESCO market growth have been Japan's commitment to the Kyoto Protocol, the rise of crude oil price; and the revision of its Energy Conservation Law.

Barriers to Further Development

A review of country specific barriers highlights a few common challenges, which include the continuous increase of material and labor costs, the existence of public distrust, a lack of accurate and easy-to-use M&V standards and tools, and more difficulties faced by small-sized ESCOs.

There are also unique barriers affecting different countries. In the U.S., the long-term payback period is found to be a major impediment for conducting building projects. In China, current incentive policies give the industrial sector more favorable support than do for the buildings sector. In the EU countries, legalizing ESCO in the law is considered a top necessity. In Japan, big companies dominate the ESCO market, making it hard for smaller ones and new comers to grow.

Recommendations

We offer some recommendations in the last section of the report for policy makers in China. Firstly, we highlight three progressive trends that influence ESCOs in doing projects on buildings.

***Holistic policy approach**:* A comprehensive and high-aiming policy framework can increase business opportunities for ESCOs, because there will be higher demand for technical support and services. Business opportunities can exist at a building's design, construction, and operation stages, as well as in the application of renewable energy on buildings.

Total building approach: The purpose of taking a whole system approach is to obtain synergistic effects. For building energy efficiency, the whole building approach includes whole building design and whole building retrofit, both will rely on an integrated team process, in which the design team and all affected stakeholders work together throughout the project phases.

Web-based service: To expand the market and offer better services to customers, experts have suggested that ESCOs can utilize smart, web-based energy monitoring and reporting tools. By design, this service model integrates various players to exchange information and participate in the decision-making process. Smart, web-based energy monitoring and reporting tools are expanding their applications rapidly because of continued dramatic progress in IT technology. "Intelligent efficiency" is becoming a new paradigm.

Secondly, we offer three suggestions on how China may enhance its current incentive programs.

- ***Broaden coverage of the existing incentive schemes*** to provide support to more than just shared-savings type of ESCO projects
- ***Lower the minimum energy saving bar in the incentive schemes***, as the current threshold for receiving subsidies is difficult to reach by most building projects. Another possible approach can be to set the threshold for receiving subsidies as a percentage of energy consumption reduction compared with the facility itself.

- ***Design tiered incentives to catalyze market transformation***, as China's current flat and narrowly-focused incentive scheme misses to play the important role of stimulating innovation and market transformation.

Finally, we would emphasize the urgency of ***issuing detailed M&V standards and government-certified, user-friendly simulation tools*** for M&V, because the lack of specific standards and common tools greatly hinders ESCOs' ability to take on building projects in China.

Introduction

Since the oil crisis of the 1970s that woke up the world to recognize the strategic importance of energy conservation, a business model known as energy service company (ESCO) or energy performance contracting (EPC) has been practiced in many countries to help both the public sector and the private sector identify and realize opportunities in energy conservation and energy efficiency. The basic concept of the ESCO business is that an energy service company develops, installs, and fully or partially finances upfront certain energy efficiency measures in a customer's premise or facility and receives compensation over a period of time through a performance contract that is directly tied to energy and/or dollar savings achieved (Larsen, Goldman, & Satchwell, 2012; Bertoldi P. , 2011; Marino A. , Bertoldi, Rezessy, & Boza-Kiss, 2010).

The United States was an early adopter of the ESCO model beginning in the mid-1970s, even though the U.S. ESCO industry taps less than 10 percent of the energy efficiency potential (Goldstein, 2013). Europe has also been active in promoting the ESCO model since the 1980s. In Japan, the ESCO industry came to form in the late 1990s; and around the same time, China also started its ESCO business and termed it energy management contract (EMC).

ESCOs have met with varying degrees of success in different countries and sectors, indicating the existence of important barriers to its wider application. To shed some lights on what the future may hold for the ESCO industry, this report reviews the current status of ESCOs in the United States, China, the European Union, and Japan, including the characteristics, business models, the supporting policies, and the main barriers to their further development.

Developed within the U.S.-China Clean Energy Research Center's (CERC) Building Energy Efficiency Program, this report pays particular attention to the ESCO business in the buildings sector, where information is available. The primary purpose of this report is to provide some useful resources and analyses to policy makers in China with a view to facilitating the country's drive for "energy conservation and emissions reduction", a top national goal since 2006. Accelerating the growth of China's relatively small ESCO business will create more opportunities and needs for international learning and business collaboration, while also directly benefiting the global action on climate change.

The first chapter introduces ESCOs' common types, business models, financing approaches, and project processes used in the U.S., China, the EU, and Japan. Chapter two examines the ESCO market, and chapter three surveys supporting policies in the countries and the region covered by this report. Chapter four discusses barriers and challenges faced by ESCOs, and the last chapter presents some recommendations for Chinese policy makers on what additional policy measures or improvement can help the growth of the ESCO industry.

Chapter 1. ESCO Types and Business Models

Energy Service Companies (ESCOs) can be generally categorized by ownership, business scope, or financing mechanism. Although ESCOs may be considered somewhat differently in different countries and regions, they all have the following key characteristics (Bertoldi & Rezessy, 2005):

1） An ESCO guarantees energy savings or the same level of energy service at a lower cost;
2) The remuneration of ESCOs is linked to the energy savings achieved;
3) An ESCO typically finances or assists in arranging financing for the energy efficiency project to be implemented;
4) An ESCO retains an on-going operational role in measuring and verifying the savings over the financing term.
Therefore, ESCOs accept a certain degree of risk for the achievement of improved energy efficiency in a customer's facility.

1.1 ESCO Types by Ownership

In the **United States**, ESCOs generally fall into four types by ownership:

1. Companies that are owned by building equipment companies or control manufacturers;
2. Companies that are subsidiaries of electric or gas utilities;
3. Companies that are owned by other energy companies as gas producers and pipeline owners; and
4. Companies that are independent of the abovementioned three types and offer engineering services (Goldman, Hopper, & Osborn, 2005).

Among the four, building equipment manufactures had the biggest share of the ESCO market in 2008 (Table 1). The ESCO industry in the U.S. has been dominated by big companies. In 2007, eight companies with revenue over U.S. dollars $100 million accounted for 79 percent of the industry activity and in 2008, twelve companies with revenue over $100 million accounted for 88 percent of the industry activities (Satchwell A. , Goldman, Larsen, Gilligan, & Singer, 2010).

TABLE 1. ESCO BUSINESS TYPE AND MARKET SHARE IN THE U.S. (2008)

Company Type	Number of Companies	Percent share of 2008 U.S. ESCO industry revenues
Building equipment manufacturers	4	49%
Utility affiliates	5	8%
Engineering services companies	25	22%
Other energy companies	10	21%

Source: Larsen, P., Goldman, C., & Satchwell, A. (2012). Evolution of the U.S. energy service company industry: Market size and project performance from 1990-2008. Energy Policy, 802-820.

In **China**, the first three ESCOs were started in 1997 through a World Bank supported multi-year energy efficiency program (Wang S. , 2010). Under the China-World Bank program, three pilot ESCO companies were established in Beijing, Liaoning Province and Shandong Province to demonstrate the ESCO business mechanism. From 1997 through June 2006, these companies carried out 453 projects with a total investment amount reaching 1.26 billion RMB (approx. $170 million). The three ESCOs earned a total net profit of 420 million RMB (approx. $55 million), while their customers were reported to have financially gained 8 to 10 times more (Wang S. , 2010).

By the end of 2012, China had 4,175 companies engaged in EPC, employing over 400,000 workers. While we have not seen any publications describing the main types of Chinese ESCOs by ownership, by skimming through the government published lists of registered ESCOs, one can get an impression that the majority of the Chinese ESCOs are of “science and technology” type, implying no close association with utilities and manufacturers. Most of the existing ESCOs are small- and medium-sized in terms of revenue, with only 6 of them realized 1 billion in Chinese currency *renminbi* (RMB) in revenue, 18 reached over 500 million RMB, and 83 achieved over 100 million RMB (Wang S. , 2010).

In the **European Union**, the number of ESCO companies is estimated at between 650 and 1,040 based on a survey of 27 EU member states carried out in 2009-2010 (Marino A. , Bertoldi, Rezessy, & Boze-Kiss, 2011). Germany, Italy and France have large number of ESCOs, while in other countries only a few ESCOs are established. ESCOs in the EU are dominated by international manufactures of building automation and control systems and energy service and supply companies providing facility management services, and most of them do not count ESCO services as their core business. Table 2 summarizes the type of ESCOs for the majority of the EU member states as of 2009 (Marino A. , Bertoldi, Rezessy, & Boza-Kiss, 2010).

TABLE 2. TYPE OF ESCOS IN SELECTED EU MEMBER STATES AS OF 2009

	Country	Type of ESCO	Number of ESCO
Nordic	Demark	• International small sized manufacturers of building control systems • Facility & operation companies	10
	Finland	• National and international manufacturers of building automation & control systems • Facility management and Operation & Control companies • Consulting/engineering	8
	Sweden	• International medium sized manufacturers of building automation & control systems • Facility & operation companies	5 -10
West	Belgium	• Larger international manufacturers of building automation & control systems	1 public, 7 large, and 5-7 small
	France	• Subsidiaries of large national and international companies • Facility management and operation companies • Manufacturers of building automation & control systems	10 big companies 100 small companies
	Ireland	• Consulting and engineering firms • Energy service & supply companies • Facility management companies	13 small companies 2 big companies
	Netherlands	• Energy services companies • Construction companies • Engineering companies	50
	United Kingdom	• Subsidiaries of large international manufacturers of building automation & control systems • Energy service & supply companies	20
Central	Austria	• Mainly Energy service & supply companies and consulting/engineering firms	5 - 14
	Czech Republic	• Manufacturers of building automation & control systems • Energy services and supply companies	8-10
	Germany	• Energy suppliers and manufacturers of building automation & control systems	250 - 500
	Hungary	• Local small and medium companies • Subsidiaries of energy suppliers • Multinational ESCOs	20 - 30
	Poland	• Energy services and supply companies	3 -10
	Slovenia	• N/A	2 -5
	Slovakia	• Energy consultant companies • Manufacturer of building automation & control systems	5

	Country	Type of ESCO	Number of ESCO
East		• Energy service companies	
	Bulgaria	• Small local building manufactures.	20
	Estonia	• N/A	2 (in 2007)
South	Italy	• Subsidiaries of large international companies • Small-medium size ESCOs (90 percent of ESCOs)	100-150
	Spain	• National and international large utilities, construction and multi-services companies	>15
	Greece	• Energy Services • Facility management companies	2

Source: Compilation of the results of the EU ESCOs survey in 2009 *(Marino A. , Bertoldi, Rezessy, & Boza-Kiss, 2010)*

In **Japan**, the number of ESCO companies has grown from merely eight in early 2000 (Murakoshi, Nakagami, & Sumizawa, 2000) to 104 registered with Japan Association of Energy Service Companies (JAESCO, 2012). Most companies are a division of large utility, construction, engineering and building system and electric equipment companies (Murakoshi, Nakagami, & Sumizawa, 2000).

To summarize, most ESCOs in the U.S., the EU, and Japan have existed as a subsidiary of large building equipment and control manufactures, energy service and supply companies, and facility management companies, and only a few are operating independently. In China, the situation appears to be opposite; although no definitive reference is available.

1.2 Business Models

Broadly speaking, there are two types of energy service contracting arrangements: performance-based and non-performance-based.

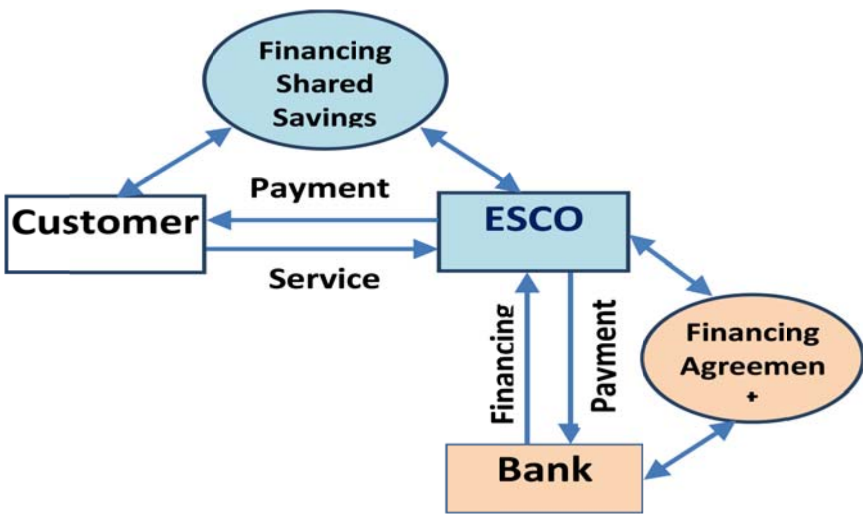
Under a performance-based contract, the ESCO receives payment is based on a contractually agreed level of energy-efficiency improvement achieved. Under a non-performance-based contract, the ESCO receives payment that is not directly linked to the energy saving results. In the former case, the customer does not need to make an upfront capital investment for implementing certain energy efficiency measures (European Association of Energy Services Companies, 2011). In other words, the customer's intangible energy-efficiency improvements will be monetized into tangible cash flow which will be shared with the ESCO (Wagner L. , 2010).

Shared Savings Model

The shared savings model is the original energy performance contracting model with the intent to have both the ESCO and the customer act more like partners and thus share project investment risk and savings (Farnsworth G. , 2007). In a shared saving contract, the ESCO and the customer enter into a long-term (typically 10 years) contract where both parties agree to share the costs and the savings calculated based on energy saved as a result of adopting energy conservation measures. The calculation of the amount of energy saved is through a mutually agreed and specified protocol of energy measurement and verification.

In the shared savings arrangement, the ESCO typically will provide financing to the energy conservation project, assuming the financial risk in addition to the performance risk (Goldman, Hopper, & Osborn, 2005; Larsen, Goldman, & Satchwell, 2012). The customers who favor the shared savings arrangement usually do not want or cannot afford to assume the financial risk. The underlying reason is often not the risk itself, but capital rationing, whereas the customer is either a division of a larger organization that will not give it the capital budget or the customer is concerned that more debt on its balance sheet would look bad to rating agencies (Goldstein, 2013). Figure 1 illustrates the shared-savings model where third-party-financing is used.

FIGURE 1 SHARED-SAVINGS: ESCO TAKING THE FINANCING RISK

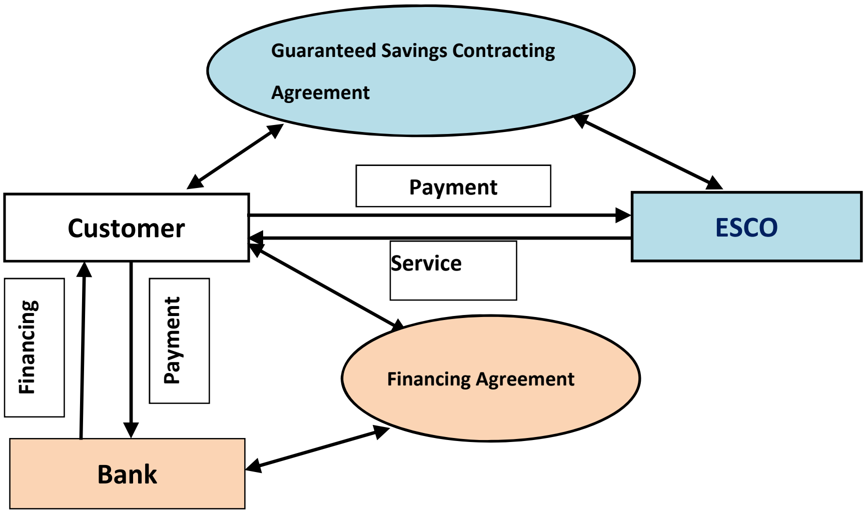


Source: (Bertoldi P. , 2011)

Guaranteed Savings Model

Guaranteed savings model is an alternative option in energy performance contracting. In a guaranteed savings contract, the ESCO guarantees a level of energy savings below which it will pay the difference and thus shields the customer from assuming any performance risk. But in order to concentrate on delivering guaranteed energy savings the ESCO normally does not provide financing itself, and instead the customer agrees to take on financing risk typically through a third-party lender such as a bank, insurance company, or lending institution. The customer repays the loan and assumes the repayment risk, but if cost savings achieved from reduced energy consumption are not enough to cover the debt service, the ESCO has to cover the difference. If energy savings exceed guaranteed level, the customer keeps the surplus (EU ESCO, 2011). Figure 2 illustrates the guaranteed-savings model.

FIGURE 2 GUARANTEED-SAVINGS: CUSTOMER TAKING THE FINANCING RISK



Source: (Bertoldi P. , 2011)

One of the biggest benefits using the guaranteed savings contract is that the guarantee would help the customer reduce the financing costs. Banks in general are willing to offer much lower interest rate because of greater certainty on energy savings expected, resulting in lower financing costs for the customer and more investment for the same project(s) (Wagner L. , 2010; EU ESCO, 2011). Of course, an ESCO has to be able to convince the customer its ability to deliver what it has guaranteed; and the customer may have a better balance sheet and credit history than the ESCO itself. For wider adoption of the guaranteed savings model, it will need an environment that has a robust and mature banking system, a well-established contract law, high proficiency in project financing, and in-house expertise in energy-efficiency (Wagner L. , 2010).

Many large ESCO projects are of this type because of the following reasons:

1. Unlike in the shared savings model, the guaranteed savings type involves a third-party financing institution, which directly faces users. Financial institutions are more experienced than ESCOs in assessing users' credibility. They can usually bear higher risks.
2. In many cases, a user's credibility rating is higher than that of an ESCO.
3. By separating project financial risks and performance risks, the ESCO can focus on providing specialized energy saving services.

Chauffage Model

The Chauffage model is a form of non-performance based contracting, in which the payment for energy efficiency services is usually calculated based on the customer's existing energy bill minus a certain percentage of monetary savings. In some projects, the calculation is based on a rate (e.g. monetary savings per square meter of a building). Still in other cases, the ESCO (usually an energy supply company) will take over the purchase of fuel or electricity (Marino A. , Bertoldi, Rezessy, & Boze-Kiss, 2011).

The Chauffage model typically involves a long term contract that includes an obligation to diagnose problems and identify needs for improvement in the system, and then implementing the projects (Bertoldi, Rezessy, & Edward, 2006). Chauffage is alternatively called "delivery contracting", supply contracting, energy supply contracting, contract energy management, and heat supply/service contract. A Chauffage contract does not explicitly commit an ESCO to make energy efficiency investment, but the provider can increase its profits by investing in energy saving equipment or by procuring cheaper fuel, thus reducing the costs.

Special Purpose Enterprise Approach

Other non-performance based contracting arrangements can be generally grouped as taking a "special purpose enterprise"(SPE) approach. In this approach, a company or a consortium is set up to be fully responsible for the designing, building, funding, owning and operating a scheme for a specified period of time and afterwards transfers this ownership to a mutually agreed party (Bertoldi, Rezessy, & Edward, 2006). Main models in this category include Build Own Operate and Transfer (BOOT), Leasing, and the First-Out model.

Under a BOOT arrangement, a special-purpose company, which can be an ESCO, owns and operates a facility and designs, finances, and carries out energy efficiency measures for a defined period of time and then transfers this ownership to a client. The client enters into a long-term supply contract with the BOOT operator and is charged accordingly for the services delivered. The BOOT scheme is becoming an increasingly popular means of financing CHP and renewable energy projects in a handful of EU countries (Bertoldi & Rezessy, 2005) (Bertoldi P. , 2011).

Leasing can be an attractive alternative to borrowing because the lease payments tend to be lower than the loan payments; it is commonly used for industrial equipment (Bertoldi & Rezessy, 2005). The leases may be made to either purchase the equipment or to rent it for a fixed period of time.

Another variation is the First-Out approach, whereby the ESCO is paid 100 percent of the energy savings until the project costs – including the ESCO profit – are fully paid (Bertoldi & Rezessy, 2005).

Table 3 shows comparisons of three major types of contracting models used in the U.S. The SPE type is not included in the table, because it is rarely used in the U.S. and China.

TABLE 3 COMPARISON OF THREE CONTRACTING MODELS

	(EPC	(EPC)	
Agent	• ESCO	• ESCO	• Energy Supply Service Company
Key characteristics	• Implementation of technical measures (ECM's) with ongoing M&V services to provide guaranteed energy savings (kWh)	• Implementation of technical improvements to provide cost savings associated with the overall energy bill	• Supply a set of energy services via the *outsourcing* of the central energy plant (primary energy conversion equipment) providing heating and/or cooling to the end-use equipment
Energy savings potential	• High. Comprehensive and detailed approach via Invest-ment Grade Audits-IGA covering both on-site energy conversion and demand side	• High. ESCO's primary focus and incentive is for energy cost savings with technical operation requirements as secondary	• Low. Limited to the central energy plant (boilers, chillers, etc.) without regard to demand-side equipment (AHUs, building envelope, space htg, lighting, ...)
Energy efficiency guarantee	• The ESCO guarantees the performance related to the level of energy saved throughout the contract life	• The ESCO guarantees the performance related to cost of energy saved throughout the contract life	• The ESC may have incentives related to energy use reduction, but without assuming any risk in case the expected efficiency is not reached
Payment	• Directly related to the energy savings achieved	• Value of payments is linked to energy prices	• Payment is at a fixed rate/tariff without any energy performance (efficiency) requirements
Contractor's risk	• Assumes technical design, implementation and performance guarantee risks	• Assumes performance and customer credit risk	• Usually does not assume tech risk (energy efficiency) neither financial risk
Energy efficiency improvement transparency	• High. The energy efficiency is measured before and after (throughout the contract life) of ECMs implementation typically following IPMVP "*International Performance Measurement and Verification Protocol*" (www.evoworld.org)	• Low. The goal is purely cost savings related to energy. Scope of work and services are not clearly defined and at the descretion of the ESCO	• Low. An specific energy bill reduction is stablished (in euros, not in kWh). Usually the contract does not take into account the measurement of the energy efficiency

Source: (EU ESCO, 2011)

Chapter 2. ESCO Market Analysis

This chapter examines how ESCO market has been growing, the current customer segmentation, types of projects, and business models in the United States, China, the European Union, and Japan, where information is available. There are comprehensive studies and surveys done in the U.S. and Europe, but scant information exists on China's ESCO industry. The last part of this chapter discusses measurement and verification on energy savings.

2.1 ESCO Market Development

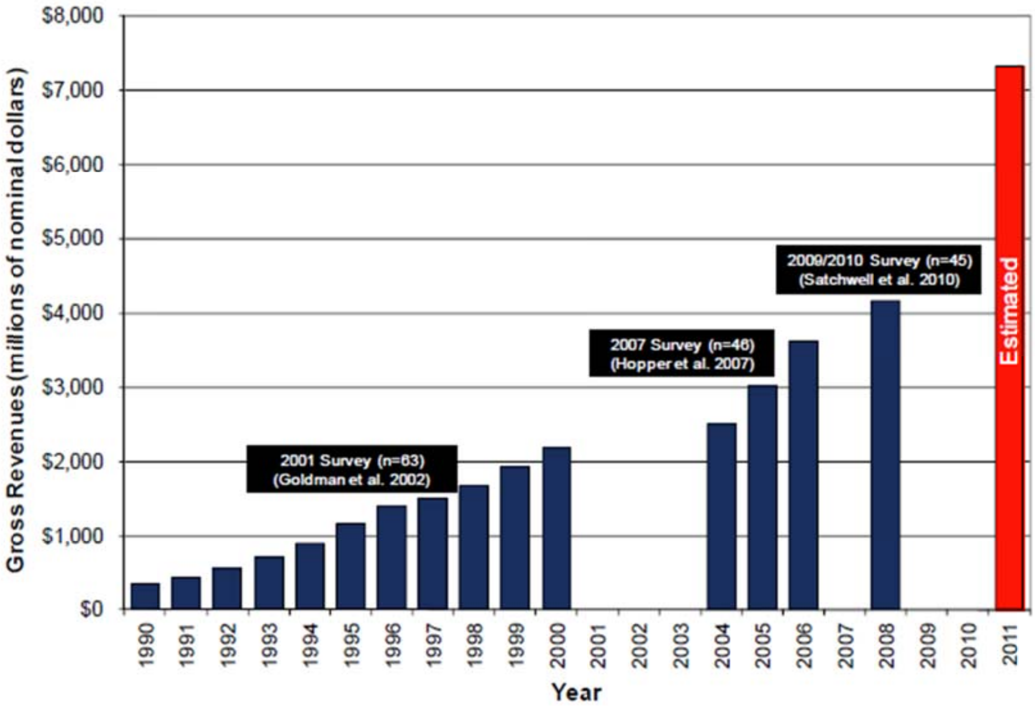
United States

ESCOs first emerged in the U.S. after the oil crisis in the 1970s as a business model to promote energy conservation and energy efficiency. This model continued to grow in the late 1980s and early 1990s when utility integrated resource planning and demand-side management were introduced (Fang, Miller, & Yeh, 2012), but it was not until the 1990s that the ESCO industry experienced an outburst of growth measured by revenue. Between 1990 and 1997, the ESCO revenue grew at a staggering annual rate of 26 percent on average as being part of the DSM program had apparently contributed to its growth (Goldman, Hopper, & Osborn, 2005; Larsen, Goldman, & Satchwell, 2012).

However, average annual growth rate of ESCO industry in the U.S. declined to 9 percent between 1998 and 2004 as the result of market saturation, collapse of Enron, expiration of Federal Energy Savings Performance Contract legislation, uncertainty brought about by electricity restructuring as well as ESCO industry consolidation and increased competition from new ESCO entrants (Goldman, Hopper, & Osborn, 2005; ICF International; NASEO, 2007). But from 2005 through 2008 the industry once again resumed its strong growth as an increasing number of states adopted energy-efficiency portfolio standards as a strategy to reduce GHG emissions and to lower cost of electricity generation (Larsen, Goldman, & Satchwell, 2012). The revenue of 2008 increased by 7 percent compared with 2006, and the survey by Satchwell et al. projected that average annual growth rate of the ESCO industry revenue between 2009 and 2011 would reach 26 percent (Satchwell A. , Goldman, Larsen, Gilligan, & Singer, 2010).

Regarding the ESCO revenue growth in the dollar amount, a 2010 study shows that the revenue of U.S. ESCO industry reached US$1.8-2.1 billion in 2000, US$3.6 billion in 2006, US$ 4.1 billion in 2008, and US$ 7.1-7.3 billion (by estimation) in 2011 (Figure 3) (Goldman, Hopper, & Osborn, 2005; Satchwell A. , Goldman, Larsen, Gilligan, & Singer, 2010).

FIGURE 3 U.S. ESCO INDUSTRY REVENUES



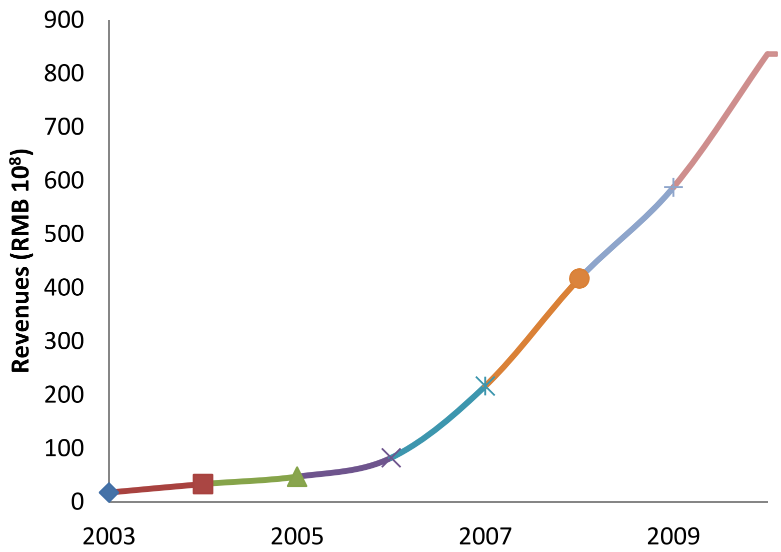
Source: (Larsen, Goldman, & Satchwell, 2012)

China

The 11th Five-Year Plan period (2006-2010) witnessed rapid growth of China's ESCO industry (ESCO Committee of CECA, 2011) (National Development and Reform Commission, 2009). The number of registered ESCOs increased 9 times, from 76 to 782, and the number of employees in this industry increased 10 times, from 16,000 to 175,000. The revenues realized by the ESCO industry grew even more rapidly -- by 16 times, from

4.73 billion RMB to 83.629 billion RMB. The corresponding reduction in CO2 emissions increased 11 times, from 2.15 million tons to 26.62 million tons.

FIGURE 4 CHINA ESCO INDUSTRY REVENUES



Source: (ESCO Committee of CECA, 2011)

European Union

Concept and practice of the ESCO model was first appeared in France in as early as the 1800s but it was not until the 1980s that the ESCO started to spread through the Europe Union (Bertoldi, Boza-Kiss, & Rezessy, 2007). Two factors were considered to be the major driving force behind the growth in the ESCO market between late 1990s and 2005 in Europe. First, the Kyoto protocol of 1997 and a string of follow-up EU directives (such as Directive 2003/87/EC and Directive 2004/101/EC) and national legislation in support of meeting the emission reduction targets; second, electricity and gas market restructuring and liberalization that was initiated in Directive 96/92/EC in 1996 and Directive 2003/54/EC in 2003 respectively, followed by Directive (COM(2003)79 final) that directly targeted energy efficiency and energy services (Bertoldi, Rezessy, & Edward, 2006).

By 2005, Germany had become the largest and most developed ESCO market in Europe, followed by France, the United Kingdom, Spain and Italy. ESCOs in Central European countries such as Austria and the Czech Republic also started gaining ground, but setback was seen in Slovakia and

Estonia of Eastern Europe as well as in Sweden due to lack of trust by facility owners on ESCOs. ESCOs were not active in Denmark and the Netherlands and Lithuania in 2005 and this was because the ESCO model was only one of the tools for delivering energy efficiency in these countries. Other European countries including Greece, Poland, Portugal, Ireland, Malta, Cyprus, Romania and Bulgaria had no ESCO activities until after 2005 (Bertoldi, Boza-Kiss, & Rezessy, 2007).

The market for energy efficiency services in Western Europe was merely at €150 million in 2000, but the market potential for the then EU 15 member states was estimated at €5-10 billion per year (Bertoldi, Rezessy, & Edward, 2006). According to a survey of EU ESCOs in 2003, in Germany alone, there were 480 ESCOs with total annual revenue of about €3 billion (Bertoldi & Rezessy, 2005).

Although there were no reliable and consistent data available on the ESCO market size for each of the 27 EU countries, the results from two comprehensive surveys on the EU's ESCO market carried out in 2006 and 2009 respectively can show whether the ESCO industry in EU was progressing (or not) (Bertoldi, Boza-Kiss, & Rezessy, 2007; Marino A. , Bertoldi, Rezessy, & Boza-Kiss, 2010)

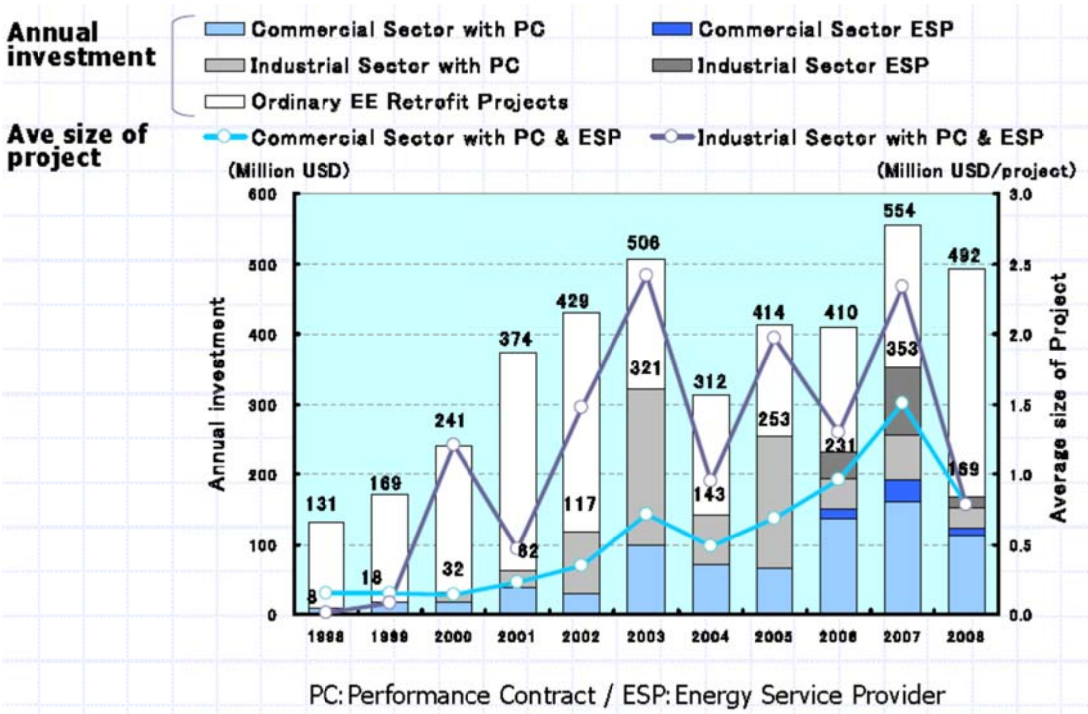
France and Germany continued to have largest and second largest ESCO market in the EU, with revenue in the France market topping €3 billion and €4-5 billion in 2006 and 2009 respectively, and revenue in the German market topping €2 billion and €1.7-2.4 billion in 2006 and 2009, respectively. Other countries that had significant revenue include (in the order of market revenue): United Kingdom (from €860-940 million in 2006 down to €400 million in 2009), Italy (€95 million for CHP projects alone in 2006 to €387 million in 2009), and Spain (over €100 million in 2009). Sweden, with strong market growth between 2007 and 2009 and reported revenue of €60 - 80 million in 2009, had also developed itself as the sixth biggest ESCO market in the EU.

Japan

ESCO activities first appeared in Japan in 1998 with the revenue reaching to US$12 million that year, representing only 5.8 percent of the total energy saving investment but that share quickly grew to 64 percent (US$416 million) in 2003 and then again US$478 million (64 percent) in 2007 (Ogawa, 2011).

Another study done by JAESCO suggested that the revenue of Japanese ESCO industry was about US$83 million in 2000 and was projected to reach US$260 million in 2001 (Kimura, 2008). Japan's ESCO market revenue reached a record high of US$353 million in 2007, but decreased to $169 million in 2008 (Nakagami, 2010).

FIGURE 5 ESCO MARKET SIZE IN JAPAN: 1998-2008



Source: (Nakagami, 2010)

2.2 ESCO Market by Customer Type

United States

In the first booming period (1990-2000) of the ESCO market in the U.S., customers from the public and institutional sector (e.g. government, educational institutions, hospitals and public housing) accounted for 73 percent of the energy-efficiency-related projects implemented by the ESCOs while projects done for the private sector accounted for only 33 percent between 1990 and 1995 and the share for the private sector shrank even further to 25 percent from 1996 to 2000 (Goldman, Hopper, & Osborn, 2005).

The U.S. ESCO market regained its vitality since 2005 and revenue of the industry in 2008 was estimated at US$4.1 billion, which was 7 percent higher compared with US$ 3.6 billion in 2006. By the market share of different customer categories, the public and institutional sector that typically include municipal, state and federal governments, universities and colleges, K-12 schools, and hospitals, the so-called “MUSH” market has continued to dominate the ESCO market in the U.S (Satchwell A. , Goldman, Larsen, Gilligan, & Singer, 2010). In a 2008 survey of the U.S. ESCO industry (Larsen, Goldman, & Satchwell, 2012), 85 percent of the projects were carried out for the public and institutional sector while the remaining 15 percent were done for the private sector. Among all types of customers, K-12 schools were the biggest customers for the U.S. ESCOs, accounting for 33 percent of total projects. State/local government and federal government followed as the second and third largest customers, respectively (Table 4).

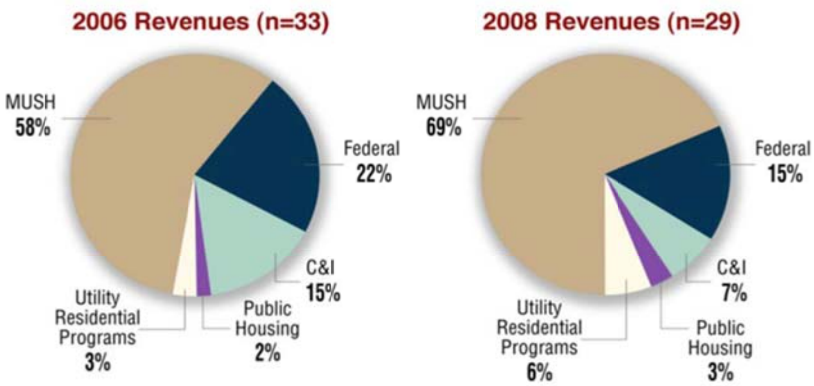
TABLE 4. ESCO ACTIVITY BY MARKET AND SEGMENT IN THE U.S. SINCE 2005

Market sector	Market segment	Percentage share of projects (n=3265) (%)
Public and institutional sector (85%)	K-12 schools	33
	State/local government	15
	Federal government	14
	Universities/ colleges	12
	Health/hospitals	8
	Public housing[a]	3
Private sector (15%)	Commercial office	6
	Industrial	4
	Retail	2
	Other	2
	Hotel/hospitality	1
	Residential	1

Source: *(Larsen, Goldman, & Satchwell, 2012)*

The "MUSH" market also brought in US$2.8 billion revenue for the U.S. ESCO industry in 2008, nearly 70 percent of total industry revenue (US$4.1 billion), 11 percent higher than in 2006. The revenue from the private sector such as commercial buildings and industry (C&I) projects has declined by 8 percent from 15 percent (about US$540 million) in 2006 to 7 percent (US$300 million) in 2008 (Figure 6) (Satchwell A. , Goldman, Larsen, Gilligan, & Singer, 2010).

FIGURE 6. SECTORAL REVENUE OF THE U.S. ESCOS IN 2006 AND 2008

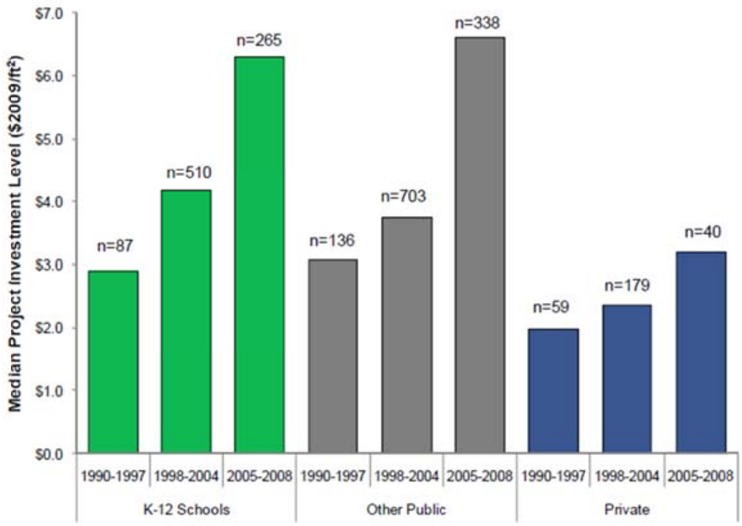


Source: *(Satchwell A. , Goldman, Larsen, Gilligan, & Singer, 2010)*

Goldman et al. believed that three reasons could explain the increased share of the public sector: (1) the nature of the project scale seen in the public and institutional sector tends to be bigger than that from the private sector, leading to reduction in transaction costs, which are particularly high in performing energy performance contract, (2) retrofit opportunities among aging public buildings and facilities in the U.S. are abundant and easy to spot, and (3) the private sector has less capital budget to spare (Goldman, Hopper, & Osborn, 2005). However, the private sector is about an order of magnitude bigger than the public sector in terms of energy efficiency potential. As the private sector is capital constrained, private owners are more reluctant to invest in projects with relatively long payback periods. Therefore, the different market shares between the private and public sectors are more likely to be the result of market barriers than due to structural differences.

On project investment level, the K-12 schools and other public/institutional sector both appeared to double their per square feet investment between 1990 and 2008 while the private sector achieved much less than that (Figure 7).

FIGURE 7. MEDIAN VALUES FOR INVESTMENT INTENSITY IN K-12 SCHOOLS, OTHER PUBLIC/INSTITUTIONAL AND PRIVATE SECTOR MARKETS: 1990-2008



Source: *(Larsen, Goldman, & Satchwell, 2012)*

China

In terms of investment levels, industrial facilities have been so far the largest customer group for the ESCO business in China. However, the building sector has had more ESCO projects than the industrial sector does (Deng & Qi, 2012). The number of industrial ESCO projects has been increasing fast (ibid). In the period of 2006-2010, 71.7 percent of total ESCO-related investments went to industry. The building sector and the transportation sector accounted for the remaining 26.3 percent and 1.8 percent, respectively (Energy Management Contract Association, 2011).

European Union

Although the ESCO industries in 27 EU countries are at different stage of development with different market sizes, there is one commonality shared among most of the member states that is the public sector has been their major customer. The countries that are exception to this are Finland, Ireland, Slovenia and the United Kingdom where the industrial sector is served as a major customer (Bertoldi P. , 2011).

Again, the two EU-wide surveys conducted separately in 2006 and 2009 looked at the type of customers the ESCO industry served, from which it is evident that the public sector is the biggest client for ESCO services in most of the EU countries. Although there is a lack of information on specific share of the public sector, responses to market value of projects implemented and/or the number of projects implemented by the industrial sector and the commercial sector from the two surveys offer observations that in general the share of industrial sector has been in decline in most EU countries. On the other hand, the commercial sector or non-private residential sector as well as the tertiary/service sector in countries like Bulgaria, the Czech Republic, Germany, Greece, Ireland the Netherlands seem to be gaining ground.

Japan

Due to Japanese government procurement laws and relevant regulations that are less favorable to ESCO industry, the public sector in Japan has never been able to tap into energy-efficiency services offered by the country's ESCOs, and as a result, the industrial sector and commercial sector have been the only two types of customers driving the ESCO market there.

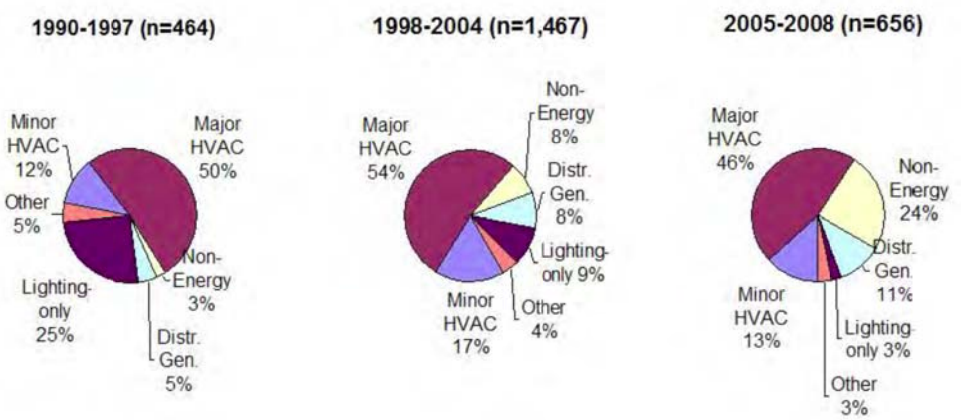
Between 2002 and 2007 the industrial sector had been the major customer in the ESCO market, but the commercial sector has surpassed the industrial sector since 2008. In Fiscal 2007, the commercial sector accounted for 54 percent (US$192 million) of the total energy contracting value (including performance-based contract, non-performance-based contract, energy supply contract) while the industrial accounted for 46 percent (US$162 million), representing a growth of 130 percent and 200 percent than a year earlier (Murakoshi & Nakagami, 2009).

2.3 ESCO Market by Efficiency Measure

United States

For the type of retrofit projects implemented by the U.S. ESCOs for their public sector customers between 1990 and 2008, major HVAC has consistently accounted for near or over half of the strategies for all public sector projects. Share of lighting-only strategy had declined significantly from 25 percent in 1990-1997 to 3 percent in 2005-2008, while on-site generation had increased from 5 percent in 1990-1997 to 11 percent in2005-2008 (Figure 8).

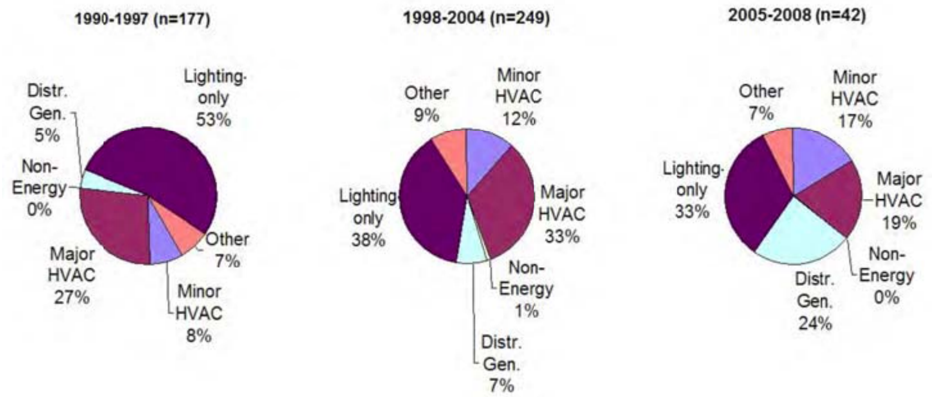
FIGURE 8 TYPES OF RETROFIT STRATEGIES USED BY ESCOS IN THE PUBLIC SECTOR PROJECTS: 1990-2008



Source: *(Larsen, Goldman, & Satchwell, 2012)*

For the type of retrofit projects implemented by the U.S. ESCOs for their private sector customers between 1990 and 2008, quite contrary, major HVAC accounted for only 27 percent of the strategies for all private sector projects in 1990-1997, and its share was down to 17 percent in 2005-2008. It was the lighting-only strategy that continued to be the dominant between 1990 and 2008, with its share ranging between 33 percent to 53 percent during that period. Like the public sector, the share of on-site generation had continued to grow from 5 percent in 1990-1997, to 24 percent in 2005-2008 in private sector (Figure 9).

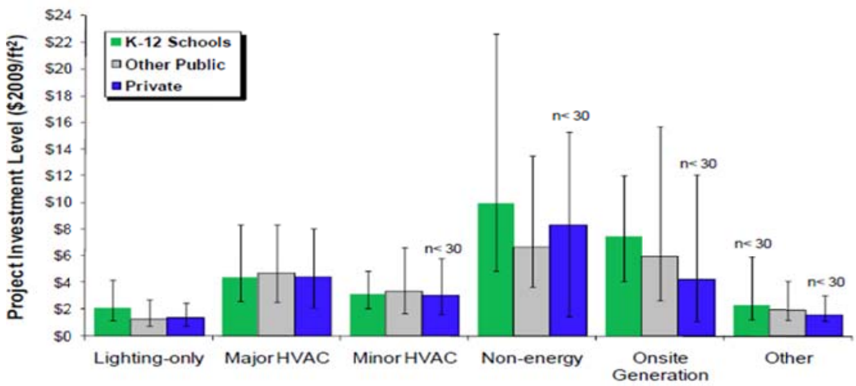
FIGURE 9 TYPES OF RETROFIT STRATEGIES USED BY ESCOS IN THE PRIVATE SECTOR PROJECTS: 1990-2008



Source: (Larsen, Goldman, & Satchwell, 2012)

On project investment level for each type of strategies used in the public-sector projects, it appeared that non-energy strategy was most investment intensive, followed respectively by on-site generation, major HVAC, minor HVAC, others and lighting-only (Figure 10).

FIGURE 10. NORMALIZED PROJECT INVESTMENT LEVELS FOR K-12 SCHOOLS, OTHER PUBLIC/INSTITUTIONAL AND PRIVATE SECTOR PROJECTS



Source: *(Larsen, Goldman, & Satchwell, 2012)*

China

We have not found any specific data on the share of various efficiency measures implemented by ESCOs in China. A few articles briefly mention that the majority of China's energy performance contracts have dealt with HVAC, lighting, motors, and waste heat recovery.

European Union

In the EU, the so-called "low hanging fruits" energy-efficiency strategies (i.e. public lighting, heating, ventilation, air conditioning, or HVAC, control system renovation) are common in energy services and projects offered by EU ESCOs, but co-generation (also known as Combined Heat & Power, or CHP) continues to play a major role, while deep retrofit such as building insulation is less common compared with the above mentioned strategies (Bertoldi P. , 2011).

The two EU-wide surveys on the type of projects carried out in 2006 and 2009 reveal that energy-efficiency strategies such as lighting, HVAC control system, co-generation, and district heating were utilized across most of the EU countries. In countries such as Finland, Ireland, Slovenia and the United Kingdom where the industrial sector was the major customer for the energy service market, improvement of production process and co-generation/CHP accounted for a bigger share and in countries like Sweden, Germany, Hungary, Italy and Greece, on-site generation, renewable energy generation, and fuel switch strategies/projects were gaining ground during the period of 2006 and 2009 (Bertoldi, Boza-Kiss, & Rezessy, 2007; Marino A. , Bertoldi, Rezessy, & Boza-Kiss, 2010).

2.4 ESCO Market by Business Model

United States

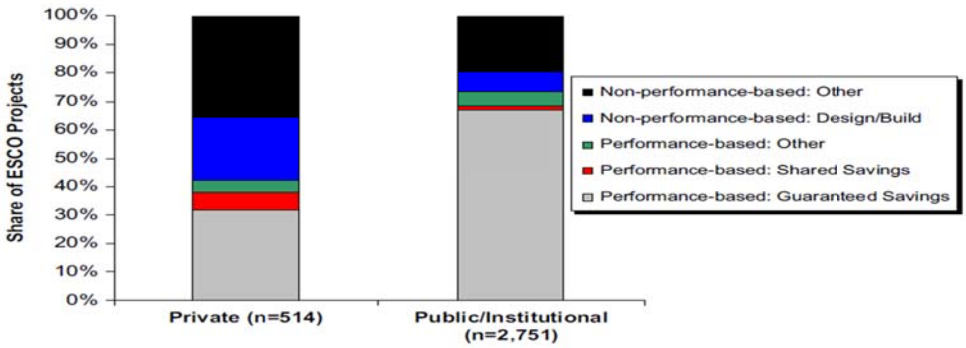
As mentioned earlier, energy performance contracting has long been a distinguishing feature of the U.S. ESCO industry. Between 1990 and 1995, performance-based contracting accounted for 70 percent of the market value of all types of contracting but this share decreased to 60 percent in 1996-2000; in terms of share of total number of projects implemented, performance-based contracting accounted for 92 percent but this share also decreased by 26 percent to 66 percent (Goldman, Hopper, & Osborn, 2005) in 1996-2000. Overall between 1990 and 2008, energy performance contracts accounted for 65 percent of 3265 projects in a comprehensive U.S. ESCO database[1] and the public sector particularly favor such type of contracting than the private sector: 73 percent of the public sector used this contracting as opposed to 40-45 percent of the private sector used it (Larsen, Goldman, & Satchwell, 2012). Between shared savings contracting and guaranteed savings contracting, shared savings has become much less common than guaranteed savings since early 2000. Of performance-based contracts collected by the above U.S. ESCO database between 1990 and 2000, 86 percent was guaranteed savings (Goldman, Hopper, & Osborn, 2005). However, the public sector is apparently much more in favor of guaranteed savings contracting than the private sector. In the same U.S. ESCO database, 67 percent of the public sector used guaranteed savings while only 32 percent of the private sector used it (Figure 11) (Larsen, Goldman, & Satchwell, 2012).

Three reasons may explain the public sector's preference of guaranteed savings: 1) a greater certainty of savings as energy-efficiency technologies advance, 2) lower financing costs because most public and institutional customers can obtain tax-exempt financing and 3) lower transaction costs

[1] The ESCO database project is a collaborative effort by National Association of Energy Service Companies (NAESCO) and Lawrence Berkeley National Laboratory.

because ESCOs can focus on project performance (Larsen, Goldman, & Satchwell, 2012).

FIGURE 11 CONTRACTUAL ARRANGEMENTS IN ESCO PROJECTS IN THE U.S.: PUBLIC VS. PRIVATE SECTOR



Source: (Larsen, Goldman, & Satchwell, 2012)

But reduced technical risk as a result of maturity and advancement of energy-efficiency technologies has seemed to become a potential threat to the guaranteed savings contracting model, as an increasing number of ESCOs' customers are reportedly using other non-performance-based type of contracting such as "fee-for-service" or "design/build". This observation seems to support a hypothesis that ESCOs can be a bridge to overcoming market failures that cause customers to fail to invest in energy efficiency. After a period of time, the successful ESCO experience gets customers to realize that they could take responsibility for savings and financing of the energy efficiency measures themselves and only use the ESCO as the design/build contractor. This would be a good thing. Other explanations include unbundling service offerings which give customers a chance to evaluate M&V costs and performance risk separately and thus gain a better understanding of the risk/reward trade-off. However, whether this trend would continue remains to be seen.

China

Like in the U.S., there have been more ESCO projects based on guaranteed savings than based on shared savings in China. The former accounted for 57 percent of the ESCO market share and the latter 32 percent during the 11th Five-Year Plan period. The Chauffage type took 8 percent and other types shared the remaining 3 percent of the market (Wang S. , 2008).

However, China's current government incentive program supports only shared savings type of projects by providing a one-time bonus to a qualified ESCO. The main criteria for funding include 1) the ESCO will invest over 70 percent in the project; 2) the ESCO's registered capital is over RMB 5 million; and 3) a single project will achieve annual energy saving of equal or over 100 tons of standard coal equivalent (tce), but below 10,000 tons of tce; for an industrial project, the threshold is above 500 tons tce (China State Council, 2010). This means only relatively large ESCOs and large projects may obtain the financial support. This is not generally favorable for projects on buildings.

Government incentives aside, financing for ESCO projects in China can come from three sources: debt financing, equity financing, and carbon-based financing, such as the Clean Development Mechanism for developing countries under the Kyoto Protocol of the United Nations Framework Convention on Climate Change (Dai, Research on Financing Model of Chinese Energy Management Contract, 2005) (Zhou, 2009) (Wang & Hu, 2007) (Wang S. , 2008). The main differences between equity financing and debt financing are given in Table 5.

TABLE 5 DIFFERENCES BETWEEN EQUITY FINANCING AND DEBT FINANCING

	Debt financing	Equity financing
Terms	Generally short (some bonds are longer)	Investors normally do not have the redemption option, so it is long-term in general.
Costs	Debt interest is closely linked to the market interest rate. Costs of issuing bonds and tax shield effect are low.	The cost of issuing equity shares is higher. Shareholders tend to demand higher returns and they may intervene in the business operations.
Risks	Companies have limited debt payments. If insolvency happens, the creditor has limited rights to obtain corporate assets.	If bankruptcy liquidation happens, the right of the shareholders comes after that of creditors

Source: (Xie, Ding, & Xie, 2011)

European Union

The most popular type of contracting in the EU overall is still Chauffage (also called Contract Energy Management, Energy Contracting), accounting for 80 percent of all contracts, and energy performance contracting, leasing, and operational contracts cover the remaining 20 percent. Chauffage enjoys dominance in France, Italy and Spain and is also very popular in Germany and the U.K. Energy performance contracting is gaining ground in most of 27 EU countries, particular in Germany, the United Kingdom and France. Among the two types of energy performance, guaranteed savings is much more popular than shared savings. BOOT contract is still rare, popular only in a handful of countries such as Italy and the U.K., and mostly is used by the industrial sector for co-generation/CHP projects (Marino A. , Bertoldi, Rezessy, & Boze-Kiss, 2011; Bertoldi P. , 2011)

The two EU-wide surveys carried out in 2006 and 2008-2009 reveal that energy performance contracting, especially guaranteed savings, had become more popular in most of the EU countries during 2006 and 2009, although Chauffage or Contract Energy Performance continued to dominant the broadly-defined ESCO market in the EU. In terms of sources of funding for energy-efficiency projects, the Third-Party-Financing had also become increasingly popular during this period across most of the EU countries, while level of funding from ESCOs' internal funds or own equity had declined (Bertoldi, Boza-Kiss, & Rezessy, 2007; Marino A. , Bertoldi, Rezessy, & Boza-Kiss, 2010).

It is worth noting that in France and the UK, a unique Public-Private-Partnership (PPP) contracting model was adopted along with the operational contract for technical equipment, Chauffage, and energy performance contracting. The PPP contracting was used for the public sector to overcome a situation where traditional procurement contracts cannot be implemented because of the legal requirements for separation of phase of the design, construction, and operation of a project into different projects. The PPP model allows the public sector to pay the provider periodically during the life of projects, and allows payment to be based on performance indicators previously set out in the contract instead of repayment based only on revenue (Bertoldi, Boza-Kiss, & Rezessy, 2007). In this type of contracting, the public institution involves a third party in the process from funding, design, production, conversion and operation or maintenance of public equipment, or engaging a third party in funding and management of energy services (Marino, Bertoldi, Rezessy, & Boza-Kiss, 2010).

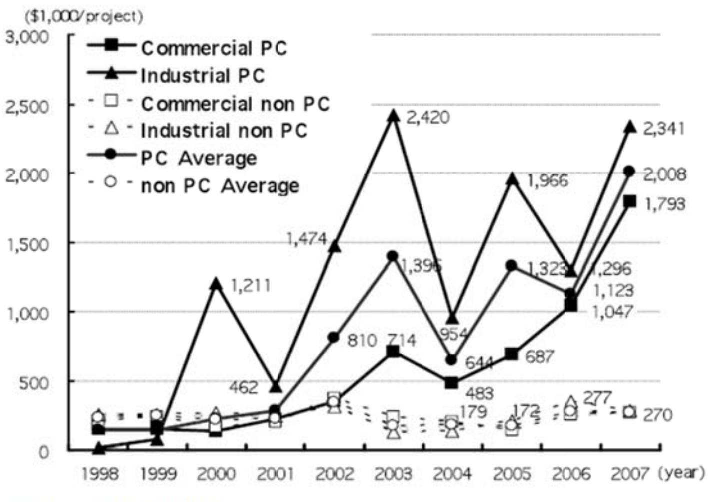
On the Third-Party-Financing, the KfW scheme created by Germany is so unique and successful that it may serve as an inspiration for countries that are struggling with funding and experience limited growth of ESCOs. KfW is a non-profit banking group jointly owned by the government (80 percent) and the Länder (20 percent). KfW manages funding from all governments and raises funds from the financial markets and transfer the capital through commercial banks to applicants for energy-efficiency programs in the form of lower interest loans. Since 2005, additional subsidies from federal government are used by the KfW both to improve the financial conditions and to expand the programs. By targeting 95 percent of the buildings in Germany, the KfW serves to promote housing construction and retrofit as well as energy conservation on the part of commercial enterprises and local communities. The KfW does not accord loans or any sort of financial product directly provided to the investor (with exception of some applicants of the public sector); it only accord loans or financial products provided to credit institutions (Marino A. , Bertoldi, Rezessy, & Boza-Kiss, 2010)

Japan

In strong contrast to the U.S. and the EU, the ESCO market had been nearly 100 percent dominated by guaranteed savings contracting since the inception of ESCOs in Japan in 1998. But this share has been on the decline since 2002 when shared savings started to become popular, and in 2007 shared savings contracts accounted for 53 percent of the market while guaranteed savings reached a record low at only 10 percent, and energy supply contracts took the remaining 37 percent. In general, guaranteed savings contracting is used for smaller-size of energy-efficiency projects while shared savings contracting and energy supply contracting are used in larger-size of investment (Ogawa, 2011). However, according to Ogawa (2011), guaranteed savings may have chance to regain its popularity since increasing financing burden of shared savings contracts is getting too large for the Japanese ESCOs.

Unfavorable public procurement laws have made the public sector disengaged from any ESCO activities in Japan, and hence the private sector has been the sole customer for all of the three types of contracts mentioned above. In Fiscal 2007, among 176 contracts set up that year the commercial sector accounted for 107 with average value per contract US$1.8 million, while the industrial sector accounted for 69 contracts with average value per contract at US$2.3 million, representing a 71 percent and 81 percent increase in term of per contract value from Fiscal 2006 (Figure 12) (Murakoshi & Nakagami, Current state of ESCO activities in Asia: ESCO industry development programs and future tasks in Asian countries, 2009).

FIGURE 12. PER CONTRACT INVESTMENT FOR JAPANESE ESCO MARKET



Source: (Murakoshi & Nakagami, 2009)

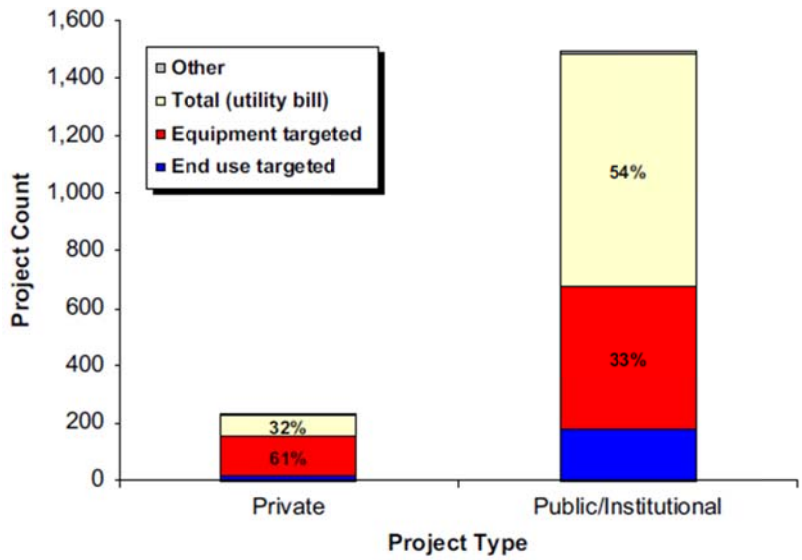
2.5 Measurement and Verification (M&V)

United States

As energy efficiency projects have become more complex, developing and adopting a standardized protocol for measuring and verifying energy-savings from taking energy-efficiency measures has become increasingly important for performance-based contracting model to succeed. Cost of measurement and verification (M&V) options can vary from low to high. Engineering estimates of project-level savings are normally less costly compared with facility-level targets based on whole building or process-level energy use or sub-metered data with statistical analysis of trends and comparison against baseline. However, excessive attention to M&V can become a costly administrative burden. (Farnsworth G. , 2007).

ESCOs in the U.S. use several M&V options including the International Performance Measurement Verification Protocol (IPMVP) to estimate savings relative to baseline energy consumption for energy-efficiency measures adopted in a project (Larsen, Goldman, & Satchwell, 2012). For less complex projects such as lighting-only projects, ESCOs reported baseline consumption only for the lighting fixtures to be replaced, while in more complex projects, ESCOs typically estimate baseline consumption using total facility energy consumption from an analysis of the customer's utility bills. In the survey of U.S. ESCO market, total facility energy consumption was the prevailing metrics (54 percent) used to measure and verify both energy and cost savings in public sector while equipment targeted metrics (61 percent) was most favored by the private sector (Figure 13). This is largely stemming from the different types of contracting preferred by the public and private sectors. As mentioned earlier, performance-based contract has the lowest financing and transaction cost and thus has long been favored by most of the public sector, resulting in bigger and more complex projects taken by the public sector over time.

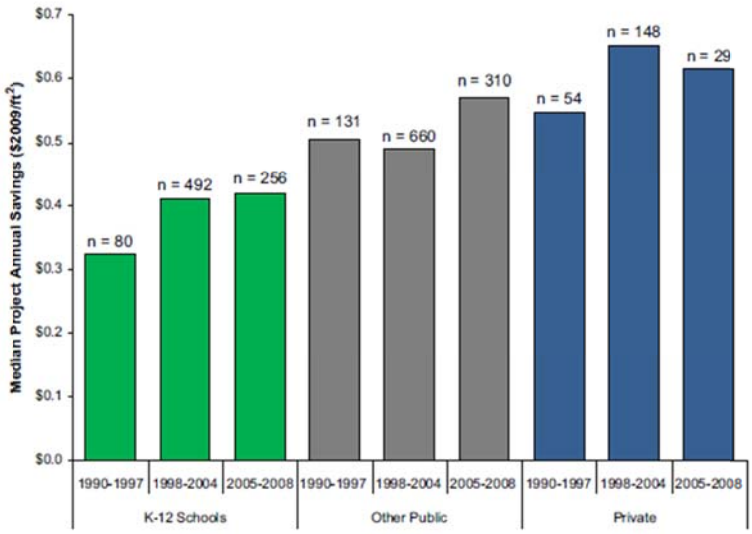
FIGURE 13. SHARE OF REPORTED BASELINE CONSUMPTION METRICS



Source: *(Larsen, Goldman, & Satchwell, 2012)*

In terms of cost savings, between 1990 and 2008 the median value for annual savings per square foot was much lower in measures installed for the K-12 schools (US$0.32-0.42/sq ft2), compared with that achieved by measures installed for other public sector (US$0.48-0.55/sq ft2) and the private sector (US$0.53-0.61/sq ft2) (Figure 14).

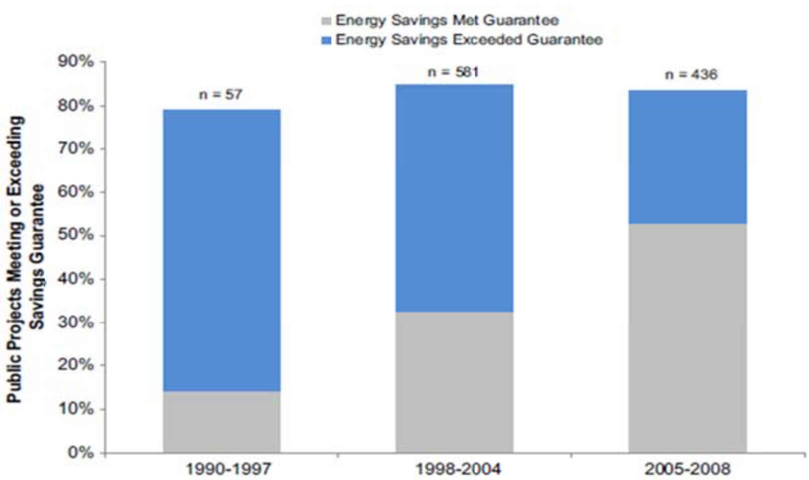
FIGURE 14 MEDIAN VALUES FOR UNIT SAVINGS OVER TIME FOR ESCO PROJECTS IN K-12 SCHOOLDS, PUBLIC/INSTITUTIONAL, AND PRIVATE SECTOR



Source: (Larsen, Goldman, & Satchwell, 2012)

Results of the U.S. ESCO database shows that the level of energy savings exceeding pre-determined guarantee has continued to decline for the public and institutional projects between 1990 and 2008 (Figure 15); however, 85 percent of these projects still met the guaranteed level of savings (Larsen, Goldman, & Satchwell, 2012).

FIGURE 15 PUBLIC AND INSTITUTIONAL PROJECTS MEETING OR EXCEEDING SAVINGS GUARANTEED



Source: *(Larsen, Goldman, & Satchwell, 2012)*

In terms of cost effectiveness of energy efficiency projects carried out by ESCOs in different market segments, projects in other public and institutional markets had longer median payback time compared to the projects for private sector customers, implying stronger capital rationing behavior in the private sector. The median payback time for projects in the public and institutional sector (except for K-12 schools) was 7–10 years for onsite generation, non-energy, and major HVAC retrofits. In contrast, median payback time for lighting-only retrofits was 2 to 3 years (Larsen, Goldman, & Satchwell, 2012).

Overall, as shown in Table 6, the median payback time in projects for K-12 schools, other public sector, or the private sector has all increased between 1990 and 2008 and thus the benefit-cost ratio has continued to decrease (Larsen, Goldman, & Satchwell, 2012). This is due mostly to the change in project scale over time, as opportunities for "low hanging fruits" measures continue to shrink and the number of complex projects is on the rise.

Table 6 MEDIAN PAYBACK TIME AND BENEFIT-COST RATIOS FOR ESCO PROJECTS BY MARKET SEGMENT

Market segment	Installation year	Simple payback time (years)	Benefit-cost ratio
K-12 schools	1990–1997	8.2 (n=125)	1.5 (n=121)
K-12 schools	1998–2004	9.6 (n=540)	1.1 (n=536)
K-12 schools	2005–2008	13.1 (n=263)	0.9 (n=263)
Other public	1990–1997	3.9 (n=225)	3.0 (n=220)
Other public	1998–2004	7.0 (n=724)	1.6 (n=708)
Other public	2005–2008	9.0 (n=353)	1.2 (n=339)
Private	1990–1997	1.9 (n=138)	4.3 (n=138)
Private	1998–2004	3.7 (n=197)	2.2 (n=185)
Private	2005–2008	3.2 (n=33)	2.7 (n=31)

Source: *(Larsen, Goldman, & Satchwell, 2012)*

China

In March 2008, the Chinese central government issued a document, entitled *Guide on Energy Saving Verification for Energy Conservation Projects* (National Development and Reform Commission, 2008). This guide provides general principles and steps for verifying energy savings after planned energy conservation measures have been completed. Further, in 2012, the government issued more detailed technical guidelines, entitled *General Technical Rules for Measurement and Verification of Energy Savings* (GB/T

28750-2012), which define the principles and rules of delineating project boundaries and calculating energy savings. Since the M&V technical rules were released only recently, most ESCO projects have not adequately planned M&V before the energy conservation measures are implemented (Yuan, Gao, & Yang, 2011).

European Union

A Measurement and Verification (M&V) Plan is required to determine the savings achieved by implementation of a national-level Energy Efficiency Programme. Like the U.S. ESCOs, members of the European Association of ESCOs (eu. ESCO) have also adopted IPMVP as their preferred guideline to write the M&V Plan as part of the Energy Performance Contracts (EU ESCO, 2011).

A level of energy savings is measured by Avoided Energy Use Formulation: that is reduction in energy consumption during the reporting period as opposed to energy consumption measured before adoption of energy-efficiency measures, which is also served as baseline energy consumption (Efficiency Valuation Organization, 2012).

Despite the existence of IPMVP since 1995, the protocol has not been widely used other than for a national-level of Energy-Efficiency Programme. This may have explained why there has been no EU-level or country-specific data, measured or estimated, on energy savings achieved in any given year or during the period of 1990-2009. A lack of standardized M&V and its low penetration has been widely cited across most of the EU countries as one of the most important barriers that prevent the growth of energy performance contracting model and the ESCO industry itself.

To address this issue, the Danish standardization institute, Dansk Standard, has been working on a European standardization model for ESCO projects that covers measurements and validation method (Marino A. , Bertoldi, Rezessy, & Boza-Kiss, 2010).

However, a study that uses the Generalized Method of Moments system estimator to attempt to estimate energy savings effect at the EU level has suggested that energy savings as a result of ESCO activities in the EU can exceed 20 percent by 2020 in the long term, but the effect varies between high-income countries and low-income countries. For high-income countries, ESCOs can effectively reduce energy use while in low-income countries ESCOs will only increase energy use (Fang, Miller, & Yeh, 2012). Even so, energy efficiency efforts in low-income countries are still worthwhile, because the increases in energy service would have happened anyway, but would have happened at lower efficiency.

Chapter 3. Enabling Policies for ESCOs

While the energy crisis of the late 1970s spurred the start of energy saving business, ESCOs lost momentum after the energy crisis came to an end, as energy prices dropped. The subsequent growth of the ESCO industry in most countries has depended on governmental policies and incentive programs that are designed to help correct market's failure on utilizing cost-effective energy conservation measures. This chapter describes the main policies and programs implemented in different countries and their impact on the growth of ESCOs.

3.1 United States

The U.S. ESCO industry had gone through three major phases of development between 1990 and 2008 including a fast growth in 1990-1997, the market decline in 1998-2005, and market rejuvenation in 2005-2008. During these times and into 2009, five major federal and state-level policies and programs have had direct impacts on the development of U.S. ESCO industry and market, including 1) Ratepayer-funded Energy-Efficiency Program, 2) Energy Savings Initiatives for Buildings, 3), Energy Efficiency Resource Standards, 4) Energy Savings Performance Contracts, 5) American Recovery and Reinvestment Act.

(1) Ratepayer-funded Energy-Efficiency Programs (REEPs): REEPs evolved in the 1980's primarily as utility demand side resource investments, in that utilities designed and implemented energy efficiency programs for their customers and regulators set policy parameters for efficiency investments concerning energy measurement and verification, approval of investment budgets and provision of incentives to align utility financial motives with ratepayer interest in achieving cost effectives efficiency investment and to avoid more expensive supply side investments (Harrington & Murray, 2003). This program encountered a setback during the electricity restructuring in the late 1990s but regained support in mid-2000s as a lower cost alternative to electricity generation and in some cases were developed to support achieving energy savings targets set out by Energy-Efficiency Resource Standards (Satchwell A. , Goldman, Larsen, Gilligan, & Singer, 2010; Brown, 2010)

As of 2009, there were 35 states across the U.S. that adopted REEPs with a total budget of US$3.1 billion in 2008 (Barbose, Goldman, & Schlegel, 2009). The budget for REEPs continued to grow and reached over US$6.8 billion in 2011, 25 percent higher than 2010 and is projected to exceed US$12 billion by 2020. In 2010, REEPs were estimated to save 112 TWh, enough to power over 9.7 million U.S. households for one year, and avoided the emissions of 78 million metric tons of carbon dioxide (Institute for Electric Efficiency, 2012). Electric efficiency savings (including both traditional energy efficiency as well as load control programs) were achieved at an average cost of 4.3 cents per kWh saved and savings from energy efficiency only (excluding and assuming no savings from load control programs) were achieved at an average cost of 3.5 cents per kWh saved in 2010 (Institute for Electric Efficiency, 2012). REEPs are projected to reduce electricity demand in the U.S. by approximately 5 percent by 2020 (Brown, 2010).

Although REEPs were not designed directly for the U.S. ESCO industry, it has significant and positive impact on the ESCO industry. For example, ESCOs would use rebates offered by utilities for installation of high efficiency equipment to buy down the initial cost of projects; ESCOs also actively participated performance-based programs (e.g. DSM bidding, negawatts) in which utilities provided incentives for verified electricity and peak demand savings in customer facilities; leveraged the value of incentives by passing some or all of the payments through to the customer, effectively reducing the cost of the project. (Goldman, Hopper, & Osborn, 2005)

(2) Energy Savings Initiatives for Buildings: Starting in early 1990s, the U.S federal government enacted the mandatory energy savings initiative, requiring all federal buildings to achieve aggressive savings targets, and this initiative was immediately adopted by several state governments to push their state buildings for better energy performance. These federal and state initiatives were considered to be a major driver for penetration of energy performance contracting among the federal buildings and “MUSH” market segment for U.S. ESCOs. Since its initial imposition until 2005, the energy savings targets for federal buildings had been raised three times, indicating all of the prior targets had been met (ICF International; NASEO, 2007).We can hypothesize that the reason why the MUSH market is so dominant is because government has mandatory energy efficiency targets while the private sector by and large

does not. Thus it would be an argument for programs like ISO 50001, the Department of Energy's Superior Energy Performance, and the EPA's Energy Star that encourage the setting of targets.

(3) Energy-Efficiency Resource Standards (EERS): Starting in early 2000s, EERS is a market-based mechanism to encourage more efficient generation, transmission and use of electricity and gas. An EERS contains electricity and/or gas energy savings targets for utilities and utilities can achieve the targets through a flexible market-based trading mechanism, by which a utility exceeds savings targets can sell the excess to other utilities that fall short of their targets; energy savings and efficiency improvement from end-user and co-generation/CHP system are normally included (Nadel, 2006). A federal-level EERS would require that electricity and natural gas utilities help their customers reduce energy use by a specified and increasing amount each year, based on a percentage of total energy sales (Alliance to Save Energy, 2011).

Detailed design of state-level EERS varies, but the cores of the standard all target electricity and natural gas utilities and prescribe level of performance based on percentage of sales or percentage of sales growth. As of late 2009, 23 States have adopted some form of an EERS (Brown, 2010). Due in part to state EERS programs, the budget for state and utility electric and natural gas efficiency programs reached US$5.3 billion in 2009, in part due to state EERS programs (Alliance to Save Energy, 2011). Studies on several state EERS suggested that this program had reduced energy consumption by 20 percent or more (Nadel, 2006).

(4) Energy savings performance contracts (ESPCs): Originally authorized in 1984 and effective in 1995, ESPCs were developed as a partnership between a federal agency and an ESCO. Under an ESPC the ESCO arranges funding, conducts comprehensive energy audit in the federal facility, and then identifies, designs, and implements a project under the premise that it guarantees that the improvements will generate energy cost savings sufficient to pay for the project over the term of the contract. After the contract ends, all additional cost savings accrue to the agency and contract terms can be up to 25 years. (U.S. DOE, 2012a). This type of performance-based contract allows federal agencies to achieve greater energy savings without the need for these agencies to cover the upfront capital costs and to receive special congressional appropriations (U.S. DOE, 2012a). This offers opportunities for

U.S. ESCOs to quickly expand their market in the public sector. ESPCs were reauthorized in the 2004 and 2005 and permanently reauthorized by the U.S. Congress in the Energy Independence and Security Act of 2007, indicating that performance-based contracting is likely to remain an important business model for the U.S. ESCO market (National Electrical Manufacturers Association, 2012; Satchwell A. , Goldman, Larsen, Gilligan, & Singer, 2010).

As of March 2010, 550 ESPCs were awarded to 25 agencies in 49 states, generating US$11 billion in energy cost savings includingUS$9.6 billion saved directly from energy projects and US$1.4 billion through reduced government spending. The U.S. Department of Energy has estimated that US$1.4 billion in annual federal energy efficiency investments will be required to meet existing sustainability requirements by 2015 (National Electrical Manufacturers Association, 2012).

(5) The American Recovery and Reinvestment Act (ARRA): the American Recovery and Reinvestment Act of 2009 earmarked close to US$41 billion for federal, state and local government for energy efficiency measures and the funding will be provided in the forms of grants, loans, tax benefits, and entitlement programs to weatherize old homes, stimulate retrofits of commercial buildings and public housing, and update military bases across the U.S. (Gibson, 2011). U.S. Department of Energy estimated US$46 million and nearly 1.2 billion kilowatt hours (kWh) will be saved if federal agencies were to implement all recommended renewable energy projects and energy and water saving measures (U.S. DOE, 2012b).

Satchwell et.al. (2010) estimated that, due in part to this legislation, the U.S. ESCO industry would continue to grow through 2011 with annual growth rate reaching 26 percent and revenue up to US$7.1-7.3 billion in 2011 (Satchwell A. , Goldman, Larsen, Gilligan, & Singer, 2010), but Gibson was less optimistic. He pointed out during the time ARRA programs were announced and onto 2011, there has been a marked decrease in energy savings performance contracts as well as ESCO revenues, suggesting that the growth of U.S. ESCO market is slower than expected, and the continuing cut of funding across federal, state and local governments will decrease budgets for energy-efficiency measures (Gibson, 2011).

3.2 China

The first government document that focused on ESCO came out in the year 2000, but the policy issued in 2005 provided larger impetus. Thereafter, a series of financial incentives were adopted by the central government. The most important policy documents for ESCOs are the following six:

1. June 2000: *Announcement on Furthering the Application of Energy Performance Contracting Mechanism* issued by former State Economic Commission;
2. April 2005: *Notice on Speeding up the Practice of Energy Performance Contracting and Promoting Energy Saving Service Industry* issued by the National Development and Reform Commission (NDRC) and circulated by the General Office of the State Council;
3. June 2010: *Interim Measures for the Management of an Incentive Fund to Support Energy Performance Contracting Projects* issued by the Ministry of Finance (MOF) and NDRC;
4. October 2010: *Supplemental Notice on Matters related to Financial Incentives for EPC Projects* issued by the General Offices of NDRC and MOF;
5. October 2010: *General Technical Guidelines on Energy Performance Contracting* recommended by the General Offices of NDRC and MOF; and
6. December 2010: *Notice on the Policies Concerning Value-added Tax, Business Tax and Enterprise Income Tax for Promoting the Development of the Energy Services Industry* issued by MOF and the State Administration of Taxation.

Appendix III gives a more comprehensive list of existing policy documents that have relevance to ESCO, totaling 29 since 2000. A brief description of each document is also given. These documents show the Chinese government's strong encouragement on using ESCOs for energy conservation; and policy support has been increasing since the 11th Five-Year Plan (Xu & Li, 2008). These policy documents can be grouped into seven types of different purposes:

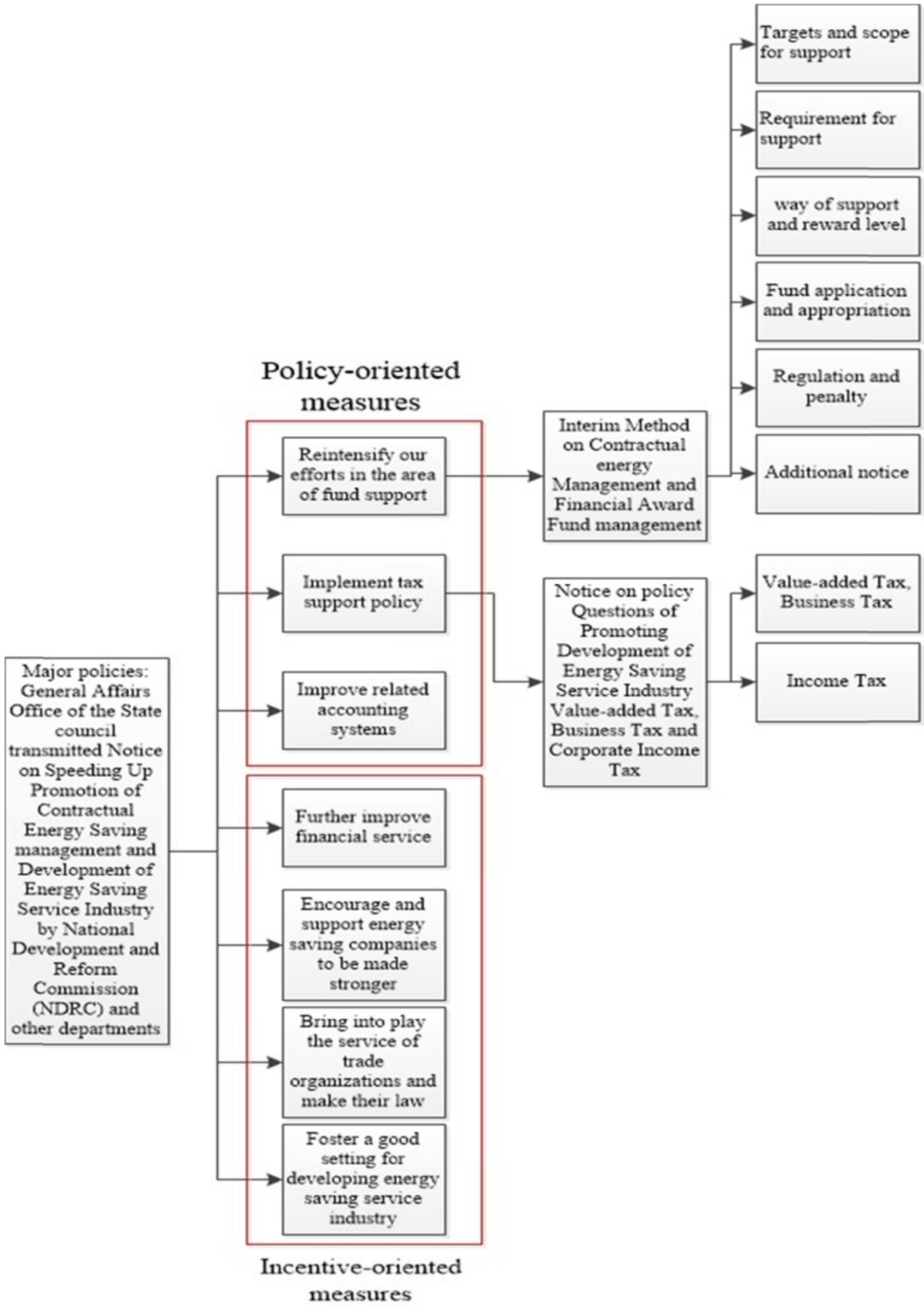
1. Providing financial support;
2. Offering tax benefits;
3. Improving accounting regulations;
4. Enhancing financing services;

5. Encouraging ESCO development
6. Encouraging ESCO industrial alliance and self-discipline; and
7. Building a supportive environment for the ESCO industry.

The first three types represent concrete measures to support ESCOs, while the rest four groups are general expressions of support. By further examining the existing policies, we notice that only the first two types of policies have follow-up operational rules and procedures issued (Figure 16). This implies that other types of policy documents have not been as easy to implement as the first two types. Therefore, one can observe that the existing national policies cover rather comprehensively, but more detailed regulations and procedural rules are necessary for effective implementation of those policies.

At the local level, we have found that Shanghai has set a good example in supporting ESCO business. In addition to the national policies, the Shanghai government has promulgated a few local policies based on local situations. In the city’s financial incentive policy, additional incentives have been made available to ESCO projects with Shared-Savings arrangement. The Shanghai government has issued financial guidelines on energy performance contracting and on streamlining financial processes for ESCO projects. ESCO projects are further helped by several banks, including the Bank of Shanghai, the Pudong Development Bank, the Shanghai Agriculture and Commerce Bank, and Shanghai Branch of the Industry and Commerce Bank of China. These banks have published introductory information on special services for ESCOs. As a result, Shanghai is one of the leaders in ESCO development in China.

FIGURE 16 CHINA'S POLICY STRUCTURE RELEVANT FOR ESCOS



Source: By Authors

3.3 European Union

In the EU, several favorable legislative provisions and financial incentives have driven the development of ESCOs, including performance standards for new buildings, subsidies available for private homeowners of renovating their houses, and fiscal mechanisms. The liberalization of the gas and electricity markets and higher electricity prices has also helped ESCOs. Finally, the general increase of environmental awareness and resulting political support play positive roles as well (Marino A. , Bertoldi, Rezessy, & Boza-Kiss, 2010).

For example, under the European Commission's THERMIE and SAVE programs, several studies and pilot projects were implemented to promote ESCOs and Third-Party Financing activities primarily for public buildings and co-generation/CHP (Wagner L. , 2010). The Energy Efficiency Plan that was published by the European Commission in March 2011 proposed to save 20 percent of its primary energy consumption by 2020 from projections as EU leaders are aware that biggest energy savings potential comes from the building sector, which accounts for 40 percent of final energy consumption.

3.4 Japan

The growth of Japanese ESCO market since its inception in 1998 was driven by three major factors: 1) Japan's commitment to achieving its target set out in Kyoto Protocol (adopted in1997 and effective in 2005), 2) abnormal rise of crude oil price, 3) revision of the Energy Conservation Law that requires stringent regulations on facilities of the industrial and commercial sectors (Ogawa, 2011).

Chapter 4. Barriers Faced by ESCO Projects in the Buildings Sector

Although ESCOs have been gaining recognition in many countries for their significant contributions to energy conservation, they continue to face important barriers to expanding their business. In this chapter, we first describe the barriers encountered by different countries, and then summarize the common challenges and unique problems for the United States, China, the countries in the European Union, and Japan.

4.1 United States

For the commercial buildings sector, barriers typically stem from two fronts:

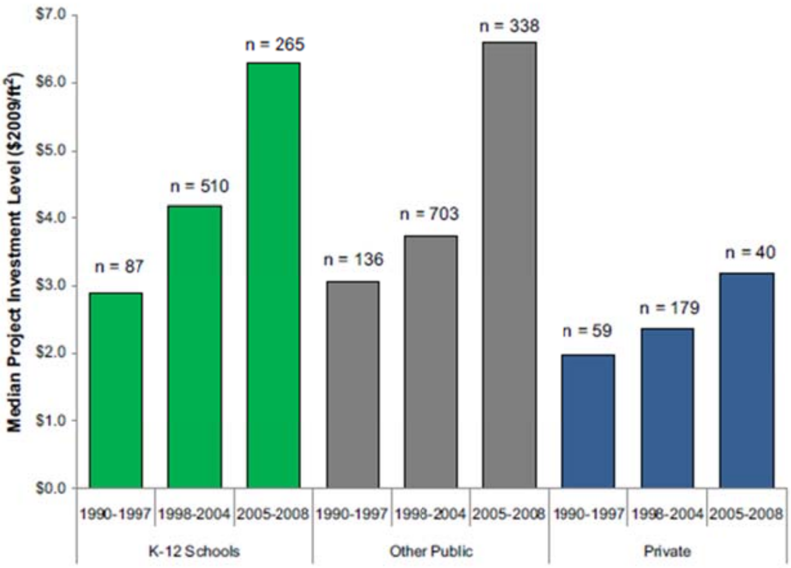
- Building owners prefer individual measures with short payback times over comprehensive options with long payback time because of higher investment hurdle rates from Third-Party-Financing. (Goldman, Hopper, & Osborn, 2005). The underlying reason for fewer interests in comprehensive projects is the existence of market barriers to realizing low-cost energy efficiency opportunities.
- ESCOs themselves are less interested in the commercial building sector because about 75 percent of the value created by ESCO investment is for resale of the property, but ESCOs typically receive payment from year-to-year savings from operating costs (Mills, 2004). This situation does not allow the full value of energy saving to be capitalized and shared with ESCOs, which is a barrier that should and can be overcome.

Other non-sector barriers include:

- Costs of project implementation increase faster than cost savings due to increase in labor and material costs as well as transaction cost. The median project cost for the public and institutional sector more than doubled between 1990 and 2008 (Larsen, Goldman, & Satchwell, 2012). Trade-off between high costs associated with collection and analysis of detailed performance data and more savings benefits as a result of data collection and analysis (Kumar & Kromer, 2006).

FIGURE 17 MEDIAN PROJECT INVESTMENT INTENSITY

FOR THREE ESCO MARKET SEGEMENT: 1990-2008



Source: (Satchwell A. , Goldman, Larsen, Gilligan, & Singer, 2010)

For comparison, it is worth noting that in the United States the industrial sector, despite their size and financial capability, has historically not been active in seeking for ESCO services. The industrial sector's ESCO market share in relation to the public and institutional sector has continued to decline. Explanations for this phenomenon include (Goldman, Hopper, & Osborn, 2005; Satchwell A. , Goldman, Larsen, Gilligan, & Singer, 2010):

- Reluctance to enter into long-term contracts due to uncertainty and short-planning cycle around business;
- Highly customized nature of industrial process improvements that requires industrial-specific expertise, thus technical risk is relatively high;
- Measurement and verification of energy savings is more challenging for industrial process retrofits; Reluctance to reveal production and technologies to outsiders that are deemed as proprietary or commercially sensitive; and
- Limited access to decision-maker within industrial companies.

The above barriers to seizing full energy efficiency potential by ESCOs point to the need for policy interventions to correction the market failures.

4.2 China

As explained in the previous chapter, the Chinese government has recognized the importance of the mechanism of EPC for helping achieve China's energy efficiency and emissions reduction goals. Therefore, the government has issued several supporting policies and financial incentives. However, the ESCO industry in China still faces major obstacles to further growth. The top three obstacles cited in various references are:

- Difficulties in financing: Most ESCOs are medium and small sized, thus have a weak ability to borrow from banks. The average payback time of ESCO projects in China is at least 3 years, often prohibiting ESCOs to take more projects; therefore, if policies can support ESCOs to use their current contract(s) for collateral to borrow more from banks, their financing difficulties can be lessened.
- Weak demand: Although energy conservation is a top national policy, there is still a lack of strong motivation on the part of customers to systematically improve energy use efficiency. Except certain industrial processes and large commercial buildings that have high energy consumption, many facilities do not feel that energy consumption is a major part of their operational costs. More carefully designed incentive programs are needed to stimulate the demand; and
- Lacking authoritative M&V standards.

Contrary to the situation in the U.S., Chinese ESCOs have been more active in the industrial sector than in the buildings sector. Our communications with various local professionals reveal that government's existing incentive design plays a role for this situation. Many building ESCO projects have difficulties to qualify for the minimum threshold on energy saving in order to receive financial help. This threshold is generally set by provincial and municipal governments at 100 metric tons of standard coal equivalent (tce) saved annually by a project, which triggers receiving government subsidies. At China's current stage of development, industrial processes present more intensive energy efficiency opportunities than buildings.

In Beijing, for example, annual saving of 100 tce or above and below 500 tce is subsidized at one-time 500 RMB per tce, including the subsidies from both the national and Beijing governments. Annual saving of more than 500 tce will receive much higher financial awards. ESCO projects on large commercial buildings can reach the 100 tce bar without too much difficulty, but the financial subsidy at this tier is not very attractive.

Take a Beijing commercial building retrofit as a rough example: the investment was around 3 million RMB and the annual electricity saving was 1 million kilowatt hours, which can be converted to about 122.9 tce; so the government's subsidy will be 61,450 RMB, which is only 2 percent of the total investment (China Real Estate News, 2011).

4.3 European Union

The development of ESCO industry among the EU countries varies from each other in terms of the number of ESCOs and market size, but differences narrow when it comes to type of customers they typically serve and type of projects they often undertake. This seems to suggest that EU countries face similar barriers.

A comprehensive survey of 27 EU countries on what the major barriers are to the development of the ESCO industry in the region has identified ten major barriers as follows (Marino A. , Bertoldi, Rezessy, & Boza-Kiss, Energy Service Companies Market in Europe - Status Report 2010, 2010):

- Lack of recognition of the ESCO model in the law;
- Lack of good understanding about the ESCO and EPC concept;
- Mistrust from the customers;
- Small-sized projects, resulting in higher transaction cost;
- High perceived technical and business risks;
- Unsupportive public procurement rules and accounting rules;
- Lack of commonly-accepted, standardized measurement and verification procedures;
- Lack of baseline data to prove the saving achieved;
- Administrative hurdles resulting in high transaction costs;
- Principal/agent dilemma with split incentives in the housing sector;
- Aversion to outsource energy;
- Customers' aversion towards long contractual terms;
- Lack of appropriate forms of finance;
- Subsidized energy prices limiting the profitability of energy efficiency investment;
- Placing a low priority for energy efficiency measures; and
- Lengthy time and effort required to bring projects to fruition.

Among them, unsupportive accounting rules typically refer to stringent regulations on what cost items should be place under investment costs versus under operation costs;

lack of off-balance sheet financing[2]; lack of public guarantees; public budgeting rule (i.e. “pressure to spend” and yearly budgets) (Bertoldi P. , Energy Service Companies (ESCOs) in Europe, 2011).

4.4 Japan

The Japanese ESCO industry has been dominated by big companies and the industrial and commercial sectors remain its only two types of customers due to lack of access to the government market.

Several issues have been cited as barriers to the further development of the ESCO market in Japan (Murakoshi & Nakagami, 2009; Kimura, 2008):

- Stringent and complex procurement laws (especially for bidding procedures) prevent access to and progress in government facilities;
- Lack of financing instrument for small and medium-sized companies;
- Small project and thus high transaction cost;
- Companies favor financing core business over energy-efficiency improvement measures;just like everyone else in the worldthis is in large part due to the failure to capitalize the value of energy efficiency in buildings;
- Reluctance of entering into long contractual terms due to risk aversion mentality;
- Reluctance of lenders to offer the customer credit that exceeds the limit the customer can obtain;
- Project implementation cost rises faster than inflation in Japan; but this situation may be changing as electricity costs are rising post Fukushima;
- Public budgeting rules (allowed for only a single fiscal year) run against long-term contracting (i.e. energy performance contracting) and long-term financing;
- Cultural practice in awarding the planning and implementation of projects to different providers; and

[2] Contrast to loans, debt and equity that appear on the balance sheet, off-balance-sheet financing such as joint ventures, R&D partnerships, and operating leases are kept off the balance sheet. Operating leases are one of the most common forms of off-balance-sheet financing, instead of purchase of capital equipment, the asset itself is kept on the lessor's balance sheet, and the lessee reports only the required rental expense for use of the asset. Generally Accepted Accounting Principles in the U.S. have set numerous rules for companies to follow in determining whether a lease should be capitalized (included on the balance sheet) or expensed (http://www.investopedia.com/terms/o/obsf.asp#axzz2NJ1gFns2).

- Choice of providers in government procurement laws is based on whether the provider's bidding price falls within the estimated price range issued by the local authority.

4.5 Common Challenges and Unique Barriers

The above review of country specific barriers highlights a few common challenges, which include 1) the continuous increase of material and labor costs, 2) the existence of public distrust, 3) a lack of accurate and easy-to-use M&V standards and tools, and 4) more difficulties faced by small-sized ESCOs. These challenges have accompanied ESCOs since the beginning of the industry, but been gradually addressed and lessened by policy interventions. The fact that ESCOs in many countries still see them as challenges points to the need for continuous policy enhancement to correct the failure of the market on recognizing energy efficiency's low-cost high-benefit nature.

Our review also indicates some unique barriers affecting different countries. In the U.S., the long-term payback period is found to be a major impediment for conducting building projects. In China, current incentive policies give the industrial sector more favorable support than do to the buildings sector. In the EU countries, legalizing ESCO in the law is considered a top necessity. In Japan, big companies dominate the ESCO market, making it hard for smaller ones and new comers.

In summary, despite the existence of huge energy efficiency potentials in the buildings sector, ESCOs in different countries are facing common and unique challenges. All those challenges or barriers will need continuous policy improvement to help overcome.

Chapter 5. Conclusions and Recommendations

After the previous chapters discussed ESCO markets, enabling policies, and barriers to further growth, this final chapter presents some recommendations for China in terms of incentive policy design, business development model, and technical approach to promote ESCO development.

First we highlight three progressive trends that influence ESCOs in doing projects on buildings.

5.1 Holistic Policy Approach

Energy conservation opportunities exist at all stages of a building's life, from design to construction, and to operation. Also, the application of renewable energy can greatly reduce a building's carbon footprint. Therefore, when developing promotional policies and incentive programs, it will be more effective to take a holistic approach than that considers all these four aspects.

Stressing a holistic policy approach may appear to be reducing business opportunities for ESCOs, as a holistic policy regime will require energy efficiency starting from buildings design phase, thus apparently eliminating later needs for ESCO services. However, in a real world, the opportunities for additional cost-effective efficiency measures will increase, to the extent that existing technologies and design measures are incorporated into the market. A holistic approach will overcome many of the barriers described in this report by increasing the awareness of energy efficiency and the trust and confidence that it will work. It will allow the owners of facilities to experience first-hand the non-energy benefits of energy efficiency, in addition to the cost savings, and make them open to further improvements down the line. In addition, few buildings ever achieve all cost-effective energy efficiency even in jurisdictions that have a history of comprehensive energy efficiency policies. A comprehensive and high-aiming policy framework can increase business opportunities for ESCOs, because there will be higher demand for technical help. For example, an ESCO may also offer consulting services in building design or re-design and in construction material selection.

Design. Energy efficiency design can reduce a building's future costs for retrofit and a building's lifecycle energy consumption. Understandably, when developing minimum energy efficiency standards, the emphasis should be placed on building form, wall and window insulation, and HVAC efficiency, because these features will be rather difficult or costly to change in future energy retrofit.

Construction. Construction materials contain large amount of embodied energy consumption, the sum of all the energy required to produce the materials. Issuing energy guidelines or mandatory energy standards for material production processes makes a major contribution to building energy efficiency from a life-cycle perspective. Green building standards also help set a higher mark by requiring making efforts to reduce energy use and carbon emissions in the building construction process. It is important to establish harmonized methodologies for calculating embodied energy and then using them to guide standards or specifications for reducing environmental impacts.

Operation. Regulating or guiding energy use by existing buildings is as important as ensuring energy efficient design and construction. It has been estimated that the use of conventional buildings represents approximately 80 percent to 90 percent of the life-cycle energy use, while 10 percent to 20 percent is consumed by the material extraction and production (the embodied energy), and less than 1 percent through end-of-life treatments (Sartori & Hestnes, 2007). In recent years, researchers and policy makers have all increased their attention to building performance and user behavior in the context of energy consumption. The various strategies being considered or adopted for enhancing energy performance and guiding user behavior include performance-based building energy labeling, building energy benchmarking and information disclosure, energy auditing, retro-commissioning, and strengthening green building certification system on building performance.

Refer to separate CERC reports for more information and discussion on reducing energy consumption in building operation: 1. *Comparative Study of Building Labeling and Rating Systems and Policies in the U.S. and China* by Meg Waltner and David Goldstein, Natural Resources Defense Council, Dec. 2012; 2. *Introduction to U.S. Best Practices in Building Retro-Commissioning* by Xiang Liu, Jingjing Qian, and Sherry Hu, Natrual Resources Defense Council, Jun. 2013

Renewable energy. The application of renewable energy in buildings has been gaining great momentum in the recent decade, especially solar photovoltaic panels, solar water heating, geothermal heating and cooling, and wind power. To obtain overall cost-effectiveness in energy-related investments, it is important that policies and incentives encourage buildings to achieve high energy efficiency first, before installing renewable energy equipment. This strategy will help cut the required renewable energy capacity to be installed.

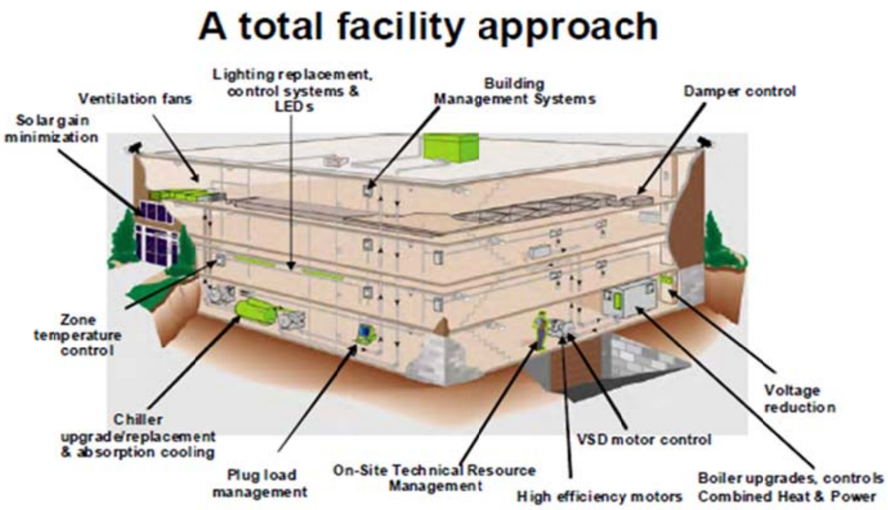
5.2 Whole-Building Approach

The concept of "whole" has been around for decades and been applied in many fields. Regardless of the field, the purpose of taking a whole system approach is to obtain synergistic effects, which separate system parts would not offer disconnectedly. For building energy efficiency, the whole building approach can be employed in building design, as mentioned above, and in building retrofit.

Whole building design consists of two components: an integrated design approach and an integrated team process. The integrated design approach asks all the building stakeholders and the planning, design, and construction teams to look at the same project objectives from different perspectives. When practicing this multi-stakeholder approach, it is necessary to have an integrated team process in which the design team and all affected stakeholders work together throughout the project phases and to evaluate the design for cost, quality-of-life, future flexibility, efficiency; overall environmental impact; productivity, creativity; and how the occupants will be enlivened.

Whole building retrofit, more commonly called "total facility approach", is gaining popularity in the United States because customers usually demand for multiple technologies to be used. The total facility approach is defined as "the installation of multiple measures that address the full range of energy efficiency and, in some cases, supply opportunities in an individual building as well as any interactive effects among system components or building systems" (Larsen, Goldman, & Satchwell, 2012) . Figure 18 illustrates a typical comprehensive retrofit for buildings.

FIGURE 18 ILLUSTRATION OF TOTAL FACILITY APPROACH



Source: (EU ESCO, 2011)

This integrated and multi-dimensional approach expands the horizon for solutions, such as life-cycle cost optimization across the investment and operation budgets, integrated planning or performance guarantees over the complete project cycle (Bleyl-Androschin, 2012). It also can reduce the cost and increase the depth of savings from retrofits. For example a lighting system retrofit will reduce the internal loads of a building, allowing a simpler and cheaper HVAC system to meet the loads. Integrating the two designs saves money and sometimes can free up the space formerly used for HVAC equipment.

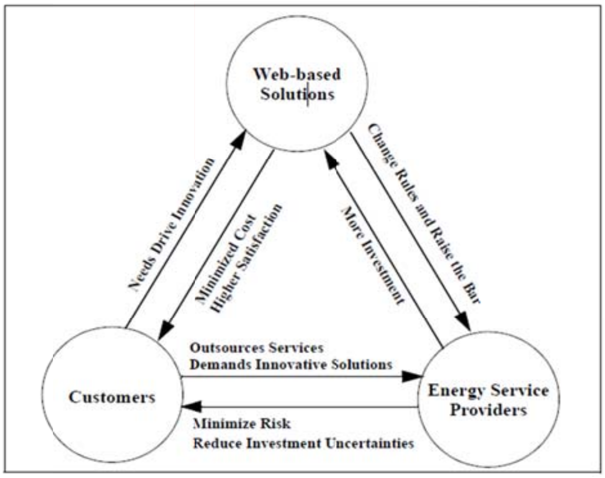
In China, currently there are not many ESCOs that can provide such an integrated solution. As shown in Appendix II, among the 18 projects we surveyed for this study, only two provide comprehensive energy-saving solutions. Other available statistics also show that even in the relatively advanced ESCO market in Shanghai, only 11 percent of the ESCO projects have utilized a relatively more comprehensive approach.
This situation highlights a need for designing specific policy interventions to encourage ESCOs and building owners look for deep energy retrofit through the total facility approach.

5.3 Web-Based Service

To expand ESCO market and offer better services to customers, Kumar & Kromer (2006) suggested that ESCOs could utilize smart, web-based energy monitoring and reporting tools. Such tools can “not only understand where and to what degree energy is being consumed but to monitor the improvements the retrofit program delivers”. This opinion echoes the expectation of emergence of a new generation of tools for energy-saving measurement and verification that can validate new streams of EPC project value, such as operations and maintenance (O&M) savings, greenhouse gas reduction and electricity system capacity credits (ICF International; NASEO, 2007) .

The benefits created by web-based solutions can go beyond conventional tangible energy savings, because intangible non-energy benefits may also be obtained, such as improved performance and health in workplaces and enhancing productivity as a result of reduction in GHG emissions (Kumar & Kromer, 2006). By design, this service model integrates various players to exchange information and participate in the decision-making process.

FIGURE 19 THE EVOLVING BUSINESS MODEL FOR ENERGY SERVICES



Source: (Kumar & Kromer, 2006)

Smart, web-based energy monitoring and reporting tools are expanding their applications rapidly because of continued dramatic progress in IT technology. “Intelligent efficiency” is becoming a new paradigm (Lacey, 2013). Such web-based tools can range from complex IT systems monitoring and analyzing hourly data to simple tools based on monthly bills alone. Policy makers should be aware of this rapidly unfolding new trend and develop policy measures that are consistent with it.

5.4 Design Robust Financial Incentives

Based on our review of China's existing policies and incentive schemes, we offer three suggestions on how China may enhance its current incentive programs in order to accelerate the development of the ESCO industry.

Broaden coverage of the existing incentive schemes on ESCO projects

As mentioned in Chapter 3, in 2010 the central government of China issued an interim regulation on providing financial incentives to certain ESCO projects. This regulation covers only shared-saving type of projects. Consequently, provincial and municipal governments rolled out specific incentive programs which all followed the central government's policy, i.e. only supporting shared-saving type of ESCO projects. This narrow coverage discourages building owners and ESCOs to undertake energy retrofit projects if they do not make shared-savings arrangements. In addition, because the current incentive scheme requires that the incentive recipient must provide over 70 percent of total project investment, the number of qualified projects is further reduced. Right now, more than two thirds of the ESCO contracts in China are not qualified for financial incentives provided by the government.

Different financing types serve different market segments and the situation changes as energy markets and customer needs change over time. In the U.S., the financial incentives do not differentiate contracting types and the level of funding is dependent on the energy saving and energy efficiency measures used. China should consider extending incentives beyond the shared-saving type in order to encourage more ESCO projects, especially on buildings. Further studies can also identify situations where incentives may not need to cost anything, i.e. if ESCOs have difficulties to access capitals, the government can design policy support to ease loan application from ESCOs.

Lower the minimum energy saving bar in the incentive programs

The above mentioned central government regulation of 2010 sets the minimum energy saving amount that qualifies an ESCO project for government financial subsidies, which is at 100 metric tons of standard coal equivalent per year (tce/year) for the whole project (equivalent of 81,4100 kWh/year). This minimum saving requirement is considered difficult to reach by many ESCOs, especially for building energy efficiency projects. For example, even for a large office building with an area of 20,000 m2 and an average energy usage of 30 kWh/m2, ten percent energy savings would result in 60,000 kwh/year, lower than the minimum energy saving criterion for receiving financial incentive. Some local governments have lowered this bar, which has been welcome by ESCOs. For instance, the Shanghai government has lowered the threshold to 50 tce/year for building projects. We recommend that the central government lower this minimum energy saving criterion across the country. Alternatively, the threshold for subsidies can be a combination of total savings and a certain percent savings self-compared. For example, if the project is smaller than x, the savings must be at least 15 percent of the current baseline level.

Design tiered incentives to catalyze market transformation

Financial incentives and subsidies are widely used by many governments to correct market failure, to help new technologies gain market space, and to transform the market. The current incentive structure as put out by China's central government is flat and narrow in scope. Although this ensures easier management than one that has a tiered and multi-category structure, it misses to play the important role of stimulating innovation and market transformation. Differentiated subsidies for different levels of efforts and technologies can help innovators and early adopters of advanced technologies to grow, as well as to encourage the majority of projects to set higher target for their energy conservation.

For example, in Northern California of the U.S., there is an incentive scheme that provides "Comprehensiveness Bonuses" for those energy conservation projects that tackle more than one system for energy efficiency. It also provides higher incentive rate for deeper energy efficiency efforts, such as 10 percent energy saving for new construction will be incentivized at US$0.033 per kWh, while 30 percent saving will get US$0.10 per kWh financing. China's current flat incentive structure should be reformed to include additional bonuses for advanced projects.

5.5 Adopt Standards on Measurement and Verification

As energy efficiency projects gradually become more complex – from single technology upgrade to "total facility" retrofit, it is important to have common standards on M&V energy savings from BEE. Widely accepted and easy-to-follow M&V standards greatly facilitate ESCO project negotiations and the application and allocation of financial incentives. They are especially critical for the ESCO projects under the guaranteed-savings arrangement, because disputes could arise between the building owner and the ESCO over the ways of calculating energy savings.

The IPMVP has been introduced to many Chinese institutions. Similarly, the Chinese government issued a national protocol in 2012, entitled the *General Technical Rules for Measurement and Verification of Energy Savings* (GB/T 28750-2012), which define the general principles and rules of delineating project boundary and calculating energy savings. However, there is still an urgent need for more detailed and specific standards and government-certified or recommended, user-friendly simulation tools for M&V, without which ESCOs' ability to carry out building projects is greatly hindered in China.

Bibliography

Harrington, C., & Murray, C. (2003). *Who Should Deliver Ratepayer Funded Energy Efficiency?*

Alliance to Save Energy. (2011). *Energy Efficiency Resource Standard.* Retrieved from Alliance to Save Energy: http://www.ase.org/sites/default/files/EERS_Fact_Sheet.pdf

Barbose, G., Goldman, C., & Schlegel, J. (2009). *The Shifting Landscape of Ratepayer-Funded Energy Efficiency in the U.S.* Berkeley, CA: Lawerence Berkeley National Laboratory.

Bertoldi, P. (2005). *Energy Service Companies (ESCOs) in Europe.* Retrieved from http://www.fire-italia.it/convegni/milanostelline2005/stel_05_conti.pdf

Bertoldi, P. (2011). *Energy Service Companies (ESCOs) in Europe.* Retrieved from Sustainable Energy Finance and Investment Summit Croatia 2011: http://www.croenergy2011.com/prezentacije/Petak/1/1.pdf

Bertoldi, P., & Rezessy, S. (2005). *Energy Services Companies in Europe: Status Report 2005.* Office for Official Publications, the European Communities.

Bertoldi, P., Boza-Kiss, B., & Rezessy, S. (2007). *Latest Development of Energy Service Companies across Europe - A European ESCO Update.* Ispra, Italy: Joint Research Center of Euroepan Commission.

Bertoldi, P., Rezessy, S., & Edward, V. (2006). Energy service companies in European countries: Current status and a strategy for foster their development. *Energy Policy*, 34, 1818-1832.

Bertoldi, P., Rezessy, S., & Edward, V. (2006). Energy service companies in European countries: Current status and a strategy to foster their develpment. *Energy Policy, 34*, 1818-1832.

Bleyl-Androschin, J. (2012). *ESCO Market Development: Business Models, Innovations and Lessons Learned.* Retrieved from IEA DSM: http://www.ieadsm.org/Files/Content/4.Trondheim_Bleyl.pdf

Brown, J. (2010). *Energy Efficiency Resource Standards (EERS): An Overview.* Retrieved from U.S. Environmental Protection Agency: http://www.epa.gov/statelocalclimate/documents/pdf/brown_presentation_1-19-2010.pdf

China Real Estate News. (2011, 4 15). *Buildings ESCO projects face difficulties for receiving subsidies.* Retrieved 8 16, 2013, from Sina Real Estate: http://news.dichan.sina.com.cn/2011/04/15/303928.html

China State Council. (2010, June 3). *Interim Measures on Incentives for ESCO Projects (Chinese).* Retrieved July 2013, from National Development and Reform Commission: http://www.sdpc.gov.cn/zcfb/zcfbqt/2010qt/t20100609_353606.htm

Dai, J. (2005). *Research on Financing Mode of Chinese Energy Management Contract.* Beijing: Central University of Finance and Economics.

Dai, J. (2005). *Research on Financing Model of Chinese Energy Management Contract.* Beijing: Central University of Finance and Economics.

Deng, X., & Qi, Y. (2012). Sinicization and Development Status of Energy Performance Contracting. *Environmental Science and Management (Chinese)*, (37)(12) 1-6.

Efficiency Valuation Organization. (2012). *International Performance Measurement and Verfication Protocol - Concepts and Options for Determing Energy and Water Savings Volume 1.* Retrieved from Efficiency Valuation Organization: http://www.evo-world.org/index.php?option=com_docman&task=doc_view&gid=1543

Energieagentur, B. (2008). *International Experience with the Development of ESCO Markets.* Berlin.

Energy Management Contract Association. (2011). *2011 Annual Energy Service Industry Report.* EMCA.

ESCO Committee of CECA. (2011). *11th Five-Year Plan: China Energy Conservation Service Industry Development Report.* China Energy Conservation Association.

EU ESCO. (2011). *Energy Performance Contracting in the European Union.* Brussels, Belgium: European Association of Energy Services Companies.

European Association of Energy Services Companies. (2011). *Energy Performance Contracting in the European Union.* Retrieved 2013, from http://www.euesco.org/fileadmin/euesco_daten/pdfs/euESCO_response_concerning_EPC.pdf

Fang, W. S., Miller, S. M., & Yeh, C.-C. (2012). The effect of ESCOs on energy use. *Energy Policy, 51*, 558-568.

Farnsworth, G. (2007). Financing Energy Saving Retrofits through International Corporate ESCOs. *ACEEE Summer Study on Energy Efficiency in Industry* (pp. 3, pp 53-64). American Council for an Energy-Efficient Economy.

Farnsworth, G. (2007). Financing Energy Savings Retrofits through Internal Corporate ESCOs. *ACEEE Summer Study on Energy Efficiency in Industry. 3*, pp. 53-64. Washington, DC: American Council for an Energy-Efficient Economy.

Gibson, B. (2011). *The future of the ESCO Industry in a Post-ARRA World*. Retrieved from Pike Research: http://www.pikeresearch.com/blog/the-future-of-the-esco-industry-in-a-post-arra-world

Goldman, C., Hopper, N., & Osborn, J. (2005). Review of US ESCO industry market trends: an empirical analysis of project data. *Energy Policy , 33*, 387-405.

Goldstein, D. (2013, August). Co-Director of Energy Program, Natural Resources Defense Council. (J. Qian, Interviewer)

ICF International; NASEO. (2007). *Introducing to Energy Performance Contracting.* Retrieved from Energy Star: http://www.energystar.gov/ia/partners/spp_res/Introduction_to_Performance_Contracting.pdf

Institute for Electric Efficiency. (2012). *Summary of Ratepayer-Funded Electric Efficiency Impact, Budget and Expenditures*. Retrieved from GreenBiz: http://www.greenbiz.com/sites/default/files/IEE_CEE2011_FINAL_update.pdf

JAESCO. (2012). *JAESCO Japan Association of Energy Service Companies.* Retrieved from Japan Association of Energy Service Companies: http://www.jaesco.or.jp/english/#

Kimura, Y. (2008). *ESCO on the rise in Japan.* Retrieved from Sustainable Development Solutions for Asia and the Pacific : http://www.sdsap.org/data/esco.pdf

Kumar, S., & Kromer, S. (2006). *Next Generation Solution fo the Energy Services Industry.* Berkeley, CA: Lawerence Berkeley National Laboratory.

Lacey, S. (2013, June 4). *Intelligent Efficiency: Innovations Reshaping the Energy Efficiency Market.* Retrieved Aug. 2013, from GreenTech: http://www.greentechmedia.com/articles/read/intelligent-efficiency-innovations-reshaping-the-energy-efficiency-market

Larsen, P., Goldman, C., & Satchwell, A. (2012). Evolution of the U.S. energy service company industry: Market size and project performance from 1990-2008. *Energy Policy*, 802-820.

Marino, A., Bertoldi, P., Rezessy, S., & Boza-Kiss, B. (2010). *Energy Service Companies Market in Europe - Status Report 2010.* Italy: Joint Research Center - Institute for Energy, European Commission.

Marino, A., Bertoldi, P., Rezessy, S., & Boze-Kiss, B. (2011). A snapshot of the European energy service market in 2010 and policy recommendations to foster a further market development. *Energy Policy, 39*, 6190-6198.

Marino, A., Bertoldi, P., Rezessy, S., & Boze-Kiss, B. (2011). A snapshot of the European energy service market in 2010 and policy recommendations to foster a further market development. *Energy Policy*, 39, 6190-6198.

Mills, E. (2004). Amplifying Real Estate Value through Energy & Water Management: From ESCO to "Energy Service Partner". *2004 ACEEE Summer Study on Energy Efficiency in Buildings. 4*, pp. 241-252. American Council for an Energy-Efficient Economy.

Murakoshi, C., & Nakagami, H. (2009). Current state of ESCO activities in Asia: ESCO industry development programs and future tasks in Asian countries. *ECEEE 2009 Summer Study.* Stockholm, Sweden: European Council for an Energy Efficient Economy.

Murakoshi, C., Nakagami, H., & Sumizawa, T. (2000). Exploring the Feasibility of ESCO Buisness in Japan: Demonstration by Experimental Study. *2000 ACEEE Summer Study on Energy Efficiency in Buildings* (pp. 231-242). American Council for an Energy-Efficient Economy.

Murakoshi, C., Nakagami, H., & Sumizawa, T. (2000). Exploring the Feasibility of ESCO Business in Japan:. *2000 ACEEE Summer Study on Energy Efficiency in Buildings.* American Council for an Energy-Efficient Economy.

Nadel, S. (2006). Energy Efficiency Resource Standards: Experience and Recommendations. *2006 ACEEE Summer Study.* Washington, D.C.: American Council for an Energy-Efficient Economy.

Nakagami, H. (2010). Recent Activities of the ESCO Industry in Japan and Asian Countries. *Asian ESCO Conference 2010.* New Dellhi.

National Development and Reform Commission. (2008, 3 14). Retrieved 6 23, 2013, from China NDRC website: http://www.sdpc.gov.cn/zcfb/zcfbtz/2008tongzhi/t20080418_205018.htm

National Development and Reform Commission. (2009). Development Status and Recommendations on EMC Industry in China. *China Science and Technology Investment*, (8)-56-58.

National Electrical Manufacturers Association. (2012). *ISSUE: Energy Savings Performance Contracts (ESPCs).* Retrieved from National Electrical Manufacturers Association: http://www.nema.org/Policy/Documents/Energy%20Savings%20Performance%20Contracts.%202012%20.pdf

Ogawa, Y. (2011). Analysis on the Role of Energy Service Companies (ESCO) Business on Energy Saving Activities. *Stockholm 34th IAEE International Conference.* Stockholm, Sweden: International Association for Energy Economics.

Sartori, I., & Hestnes, A. (2007). Energy use in the life cycle of conventional and low energy buildings: A review article. *Energy and Buildings*, 39, 249-257.

Satchwell, A., Goldman, C., Larsen, P., Gilligan, D., & Singer, T. (2010). *A survey of the U.S. ESCO Industry: Market Growth and Development from 2008 to 2011.* Retrieved February 8, 2013, from http://emp.lbl.gov/sites/all/files/REPORT%20lbnl-3479e.pdf

Satchwell, A., Goldman, C., Larsen, P., Gilligan, D., & Singer, T. (2010). *A survey of the U.S. ESCO Industry: Market Growth and Development from 2008 to 2011.* Retrieved Feb. 8, 2013, from http://emp.lbl.gov/sites/all/files/REPORT%20lbnl-3479e.pdf

U.S. DOE. (2012a). *Energy Savings Performance Contracts*. Retrieved from U.S. Department of Energy: http://www1.eere.energy.gov/femp/financing/espcs.html

U.S. DOE. (2012b). *Recovery Act*. Retrieved from U.S. Department of Energy: http://www1.eere.energy.gov/femp/financing/recovery_act.html

Wagner, L. (2010). *Energy Service Companies (ESCO) - Monetization of energy efficiency.* Retrieved from MORA Associates: http://www.moraassociates.com/reports/1002%20ESCO.pdf

Wagner, L. (2010). *Energy Service Companies (ESCO) - Monetization of energy efficiency.* Retrieved 2013, from MORA Associates: http://www.moraassociates.com/reports/1002%20ESCO.pdf

Wang, S. (2008). Development of and Existing Problem in China's EMC Industry. *China Energy*.

Wang, S. (2008). Development of and Existing Problems in China's EMC Industry. *China Energy*, 2.

Wang, S. (2010, 12 10). *ESCO Development and Challenges in China.* Retrieved 6 22, 2013, from China EMC Net: http://www.emcsino.com/html/news_info.aspx?id=2640

Wang, T., & Hu, P. (2007). Operating Mechnism and Risk Analysis of EMC. *Economics of Electric Power Technology*, (6) 44-47.

Xie, Z., Ding, X., & Xie, J. (2011). *Practice and Risk Prevention in ESCO Management.* Shanghai: Shanghai University Press.

Xu, Y., & Li, Y. (2008). Comparative study on the contract energy management mode of China. *Environmental Science and Management*, pp. 34(8), 1-8.

Yuan, H., Gao, X., & Yang, C. (2011). Current status, problems and solutions of EMC in China. *Energy Technology and Economics*, pp. 23(1), 58-63.

Zhou, F. e. (2009). Taxation Policy Model of Promoting Energy Service Industry. *Local and International Energy*.

Appendix I: Analysis of Financing Channels in China

Bank loans and bank guarantee

Chinese banks can be divided into state policy banks and commercial banks. State policy banks provide eligible borrowers with low-interest long-term loans that are usually intended for implementing national industrial policies or supporting local policy projects. Therefore, these loans have very high requirements over enterprises and projects. Currently, filing with a state-level governing body is only the first step for ESCOs to get loans from development banks and few enterprises have secured the loans so far.

Meanwhile, it is not easy for ESCOs to get credit from commercial lenders. First, most of the ESCOs in China are newly founded and they have not established a good credit record in the eyes of commercial banks. Moreover, considering the limited assets of these ESCOs, banks are usually not willing to extend credit to them. Second, the banking sector in China has not developed adequate capabilities to evaluate energy performance contracting projects (EPC) and it still lags far behind its western counterparts in terms of technological readiness, risk identification and management, which makes banks very prudent in releasing credit to EPC projects. Third, China has not put in place a fully-fledged credit system and commercial banks usually require a third-party guarantee for a loan that is not secured (in fact, banks still require a third-party guarantee even when the borrower provides a mortgage), which raises the financing threshold and costs.

In addition, the credit facilities are often based on the value of the mortgaged assets which are calculated as 70percent-80percent of the actual value. Since the value of the mortgaged assets is much lower for an energy project, other forms of guarantee are required to get loans from financial institutions. The benefits of EPC projects are reflected in their energy efficiency which is realized gradually in a long process. It often takes 5-8 years for such a project to recover the investment. However, Chinese banks generally provide loans with a tenure of not more than 5 years. Therefore, banks consider EPC projects very risky and are not willing to extend credit to them. This is one of the biggest difficulties for EPC project financing.

Bonds

The governing body for corporate bonds is the National Development and Reform Commission and an ESCO must meet the following requirements when planning to issue corporate bonds:

1. The net assets should be at least RMB30 million for a limited company and at least RMB60 million for a limited liability company and other entities;
2. The outstanding balance of bonds should be at most 40percent of the company's net assets (excluding minor interests);
3. The average distributable profit (net profit) in its recent three years is adequate to cover the annual interest for the issued bonds;
4. The funds must be raised in accordance with all the applicable requirements and they must be used in a way that is consistent with national industrial policies and is conducive to the growth of the banking industry. If the funds are used for a fixed asset investment, they should comply with the capital requirements concerning fixed asset investment projects and the issued bonds shall not exceed 60percent of the total investment of the project. If the funds are used to acquire ownership (equities), the issued bonds shall not exceed 60percent of the acquisition costs. If the funds are used to adjust the debt structure, the ratio above does not apply, but the enterprise shall provide a certificate that the bank agrees on the debt for loan repayment. If the funds are injected into the operating capital, the amount shall not exceed 20percent of the total bonds issued;
5. The bond interest rate is determined by the enterprise itself in consideration of the market conditions, but shall not exceed the upper limit set by the State Council;
6. The outstanding corporate bond or other debt does not follow an interest rate designed for circumstances of default or delayed payment;
7. No illegal or irregular behaviors have been identified in the recent three years.

ESCOs also need to find an investment bank as the lead underwriter which is responsible for the overall bond issuance structure and developing a prospectus for the issuance. However, this shall be elevated through a local branch to the National Development and Reform Commission for approval. In recent years, the Chinese bond market has remarkably expanded thanks to the country's strong push for direct financing, but it is still much smaller than the stock market. The bond market enjoys a huge potential, but is still highly restricted. Therefore, the bond market does not seem suitable for the Chinese ESCOs which are usually small and medium-sized enterprises.

Special government funds

Since commercial banks are usually reluctant to lend to ESCOs due to banks' inadequate ability to assess EPC projects, the governments at national and provincial and in many cases at city levels have set up special funds to specifically support ESCO projects or other energy efficiency projects. Since these special funds are designed to encourage energy conservation and emissions reduction, they are not profit-driven and provide grants or low-interest loans to ESCOs. For example, the Shanghai Economic and Information Commission is partnering with the Shanghai Hongkou District Government to establish a special fund for energy efficient and environment friendly industries, in a bid to promote the development of EPCs.

Compared with other financing instruments, special funds are very focused and therefore can be effective in promoting the development of ESCOs. On the other hand, the special funds are only available to specified areas and have a higher threshold for qualification.

Appendix II: Some Chinese ESCO Cases

Overview of the cases

We have collected 23 ESCO cases and present a brief summary and analysis of them below. Of the 23 cases (Table Appx II-1), 17 are reported to be successful (74percent) and 6 unsuccessful. Because few cases have been made public with details due to business confidentiality, we do not think these 23 cases can accurately reflect the full picture of China's ESCO sector. Nevertheless, these cases may still help improve our understanding of the challenges faced and progress made by ESCOs in China.

Table Appx II-1: Case study: successful projects

No.	Project	Organization
1	energy savings for air-conditioning system	A printing company
2	energy savings for water reuse system	A chemical company
3	energy savings for compressed air system	A tobacco company
4	Energy savings for thermal energy storage	A thermal energy company
5	Energy savings	A hospital
6	Energy savings for CDQ circulating fan system	A company
7	Energy savings for electric furnaces	A spring production company
8	Energy savings for government building	A district government
9	Energy savings for bell furnace	A steel rolling company
10	Energy savings for coal-fired furnaces	A brewery
11	Energy savings for central air-conditioning system	A shopping mall
12	Installation of an automatic control system to the refrigeration room of the central air-conditioning system	A building
13	Energy savings for air-conditioning in manufacturing facilities	A micro-electronics group
14	Energy savings for the water chillers of air-conditioning system	Re-Tech Group
15	Energy savings project	A five-star hotel
16	Energy savings for water reuse system	A company
17	EPC project	A commercial building

Table Appx II-2: Case study: unsuccessful projects

No	Project	Organization
1	Energy savings for CCHP system	A pharmaceutical company
2	Energy savings for the air-conditioning system of a public building	An international exchange center
3	Automatic furnace control system	A company's support center
4	Air-conditioning system upgrade	A building
5	Use of electric thermal storage boiler to supply hot water to indoor swimming pool	A sports school for children and youth
6	Air-conditioning system upgrade	A three-star hotel

Successful cases

From the two tables above, we can reach the following conclusions:

1. The reason that these organizations launched ESCO projects is because they needed to replace their old systems, and almost no organization resorted to ESCOs to upgrade their energy systems because they wanted to save energy (none of the 17 successful projects chose ESCOs because of this reason).

2. Of all these successful projects, 24percent carried out the ESCO projects because they needed to expand their capacities. By contrast, 59percent of the projects were carried out because of high energy consumption or low energy efficiency situations in their facilities.

3. In terms of the investment payback time, 39percent of the cases have less than two years, 54percent between two and three years, and 8percent more than three years. Therefore, it shows that ESCO projects generally have short payback terms, which, to a certain extent, means reduced financial risks.

Table Appx II-3: causes of unsuccessful cases

No.	Project	Causes of failure
1	Energy savings for CCHP system	Measurement of energy savings and economic benefits
2	Energy savings for the air-conditioning system of a public building	Measurement of energy savings and economic benefits
3	Automatic furnace control system	Imprecise automatic control
4	Air-conditioning system upgrade	Mistakes in initial diagnosis, lack of experience and later mishandling
5	Use of electric thermal storage boiler to supply hot water to indoor swimming pool	Measurement of energy savings and economic benefits
6	Air-conditioning system upgrade	Untimely payment for the project, part of project behind schedule and substandard quality

Analysis of the table above reveals that 50percent of projects aborted due to disagreements on how much energy could be saved, 33percent due to quality issues and 17percent due to lack of experience.

We can also make the following observations based on the analysis of these ESCO projects:

1. Although it is relatively difficult to finance ESCO projects, only a small proportion of projects failed due to payment default after successful financing.
2. In actual operation of ESCO projects, payment-related issues remain major challenges for ESCO projects, as the two parties of a project often fail to agree on measurement of energy savings and economic benefits. Although these issues are dealt with in the project contract, the two sides of the project are often unaware of these potential issues due to lack of applicable laws and regulations, and thus payment-related problems will arise.
3. Whether a project can be successful still depends on the quality of an ESCO, which will also affect the whole process of the project. A good ESCO can efficiently complete a project with high standards within the deadline, while a technologically unready ESCO may encounter problems in every part of the project process and thus have disputes with the project owner.

A typical case

To further substantiate the conclusions and issues described above, a typical case has been selected for in-depth analysis and policy recommendations are also provided in this report.

Project overview: a 30-story building in Shanghai (owner) was built in the 1990s, which houses trading activities, hotel and restaurants. The central air-conditioning system of the building originally used two 4-ton oil-fired boilers to power its two 500 RT lithium bromide air-conditioning units. The peak load of the air-conditioning system was 3185.3kW. As it was energy inefficient and had incurred high fuel expenses, the building owner signed an energy management contract (EPC) with an energy service company (contractor) to upgrade the air-conditioning system to make it more energy efficient, which was started in early 2006.

Disputes and causes: at the start the project, it was discovered that the chilled water pressure and supply did not meet the criteria specified in the contract. This dispute resulted from the contractor's mistakes in early diagnosis, lack of experience and later mishandling. The air-conditioning system had been in service for more than a decade, and the original pipeline design far exceeded what was needed by the air-conditioning system. To achieve significant energy savings, the contractor greatly reduced the power of some circulating water pumps, while impeller cutting was adopted for other water pumps to reduce their maximum power output. As a result, it was discovered that the water pressure and flow did not meet the design requirements when the cold water system was being tested. Although some corrective measures were taken, this problem was not solved. Moreover, it was also discovered that some pipelines were blocked. Therefore, even when the delivery pressure was adjusted to its maximum, the water flow still could not reach the expected criteria.

Thereafter, the two sides entered into serious disputes about whether the project could be continued. During the disputes, the owner also reported this situation to the authority above the contractor. After several rounds of negotiations, the two parties finally agreed to cancel the contract, with most of the losses borne by the contractor. In the following months, the owner was highly doubtful about the competence and qualifications of this energy service company. However, if not upgraded, the owner's air-conditioning system will not only consume a large amount of energy, but also increase its energy bills. Besides, its customers also complain that this ineffective air-conditioning system has affected their business and reputation.

Under these circumstances, another energy service company (new contractor) that specializes in air-conditioning system upgrade caught the owner's eye. After multiple times of contact and detailed diagnosis of the building's air-conditioning system, the new contractor, under extremely strict conditions imposed by the owner, signed a new energy management contract.

First, the owner divided the original project into two phases. The first phase of the project required a lot of efforts and was more difficult, but the payment for the first phase was small and all the initial expenses were borne by the new contractor. If the first phase could meet the criteria specified in the contract, the new contractor would be preferred to complete the second phase.

Taking account of such factors as the investment, funding, project difficulty and management methods, the new contractor decided to use screw water chillers with heat recovery feature to replace the former oil-fired boilers in combination with lithium bromide air-conditioning units.

The project was put into operation in June 2007. While the project was being carried out, the new contractor overcame a number of challenges such as low budget, limited available area and short project cycle and maintained close communication with the owner. All the equipment was properly installed, pipelines and cables neatly and beautifully laid out. All the technical parameters were consistent with the ones provided by their manufacturers after being tested. All the equipment was operating smoothly, and the air-conditioning system was as effective as it had been expected in design. There were no quality issues or safety accidents throughout the process, which made all customers feel confident about the upgraded system. After it was put into operation, the system could supply chilled water of 7 to 12 ℃, and its performance was obviously superior to that of the lithium bromide air-conditioning units in addition to the capability of providing hot water of 60 ℃for hygiene use. In particular, the abolition of the oil-fired boilers significantly reduced oil consumption. A total investment of RMB 1.067 million in this project can save RMB 1.157 million a year for the owner, and the time required to recover the investment is only 0.92 year, shorter than the two years set in the feasibility study report.

Appendix III：List of Current Policies Relevant for ESCOs in China

A brief description of current policies

Name of the policy	Description	Remark
Notice on Further Promotion of EPC		First policy issued by national authorities to promote EPC in China
"10th Five-Year Plan"on Energy Conservation and Comprehensive Utilization State Economic and Trade Commission **[2001] No. 1018**	Building on the success of energy service pilot projects in the Ninth Five-Year Plan, a number of energy service centers are reorganized and restructured to pursue a new mechanism for EPC implementation, improve energy technology and promote application of advanced technologies in SMEs.	China officially integrates the implementation of EPC in the tenth five-year plan for national economic and social development in terms of energy conservation.
Notice of the State Council on Resource Conservation Activities **[2004] 30**	To promote new mechanisms of EPC and financing security for energy service.	Although the state has introduced relevant policies and regulations, but these policies are not effective. And few policies were introduced in the past few years to specifically deal with EPC. EPC remains in infancy in China.
The Notice of the State Council on Priorities of Building a Resource Efficient Society **[2005] No.21**	The policy proposes to speed up development of energy service technologies and promote security system for EPC and financing. It is also designed to provide enterprises with a one-stop solution that includes diagnosis, design, financing, upgrade, operation, management.	It is the first time that the state has proposed to provide a one-stop solution that covers diagnosis, design, financing, upgrade, operation, management.
11th Five-Year Plan of National Economic and Social Development **2006.04.30 No. 12**	This document plans to speed up legislation on development of circular economy and strengthen power demand side management, government energy service procurement and EPC.	The plan sets a specific energy savings target to reduce energy consumption per unit of GDP by 20percent. EPC will also be strengthend rather than merely promoted by the state. The plan also aims to accelerate legiation on EPC.
Notice on Resource Conservation by Government Bodies **NDRC [2006] No. 284**	This policy is designed to gradually establish an energy efficiency evaluation system for government bodies and encourage professional energy service companies to help government bodies to optimize energy management and efficiency.	EPC is encouraged among government bodies
The State Council's Decision on	The policy aims to further develop the energy service system	Energy saving is placed at a more prominent

***Strengthening Energy Conservation* [2006] No.28**	and speed up EPC to encourage companies to upgrade their energy system	strategic position and the state will pay more attention to energy conservation.
***Notice of the State Council on the Promulgation of a Comprehensive Energy Conservation Plan* [2007] No. 15**	The policy is designed to accelerate the establishment of energy service system. Besides, the government also introduced the Guiding Opinion on Accelerating Development of the Energy Service Industry to advance development of the energy service market, speed up implementation of EPC and support major energy service companies to provide government buildings with one-stop energy service solutions.	The documents of the State Council has repeatedly dealt with EPC, which means EPC has attracted more attention from the state and EPC will enjoy rapid development in China.
***Energy Conservation Law* Order of the President of the People's Republic of China No.77**	Article 66: The State carries out pricing policies that are conducive to energy conservation to guide organiations and individuals to save energy. The state supports demand side management, EPC, energy conservation voluntary agreements and other energy-saving ways through taxation and pricing policies.	EPC has been included into the National Energy Conservation Law, whereby the state promotes EPC development.
***Regulations on Public Organization Energy Conservation* State Council No. 531**	Public institutions are encouraged to entrust energy service companies to carry out energy-saving diagnosis, design, financing, upgrade, operation and management.	The policy, which is dedicated to public organizations, clearly encourages public organizations to adopt EPC method to save energy
***Opinions on Saving Energy and Reducing Emissions in the Building Sector in 2008* [2008] No. 160**	The policy is designed to support development of energy service companies that specializes in energy conservation for buildings	The policy says “support development of energy service companies”, which means the government starts to pay attention to their development
***Notice of the State Council on Saving Energy and Reducing Emissions in 2009* [2009] No. 48**	The policy encourages development of EPC to speed up the development of the energy services industry, encourage professional energy-saving company to upgrade energy systems for small and medium-sized enterprises as well as public institutions.	The policy clearly encourages the development of professional energy companies.
Notice on Model Cities That Use Renewable Energy for Buildings [2009] No. 305	The policy is to develop the market for energy services and promote use of solar energy and shallow geothermal energy technology.	Encourage EPC in renewable energy buildings. In 2009, 502 ESCOs recorded an output value of more than RMB 58 billion, saving 13.5 million tons of coal equivalent.
***Notice on 2010 Priorities of Building Energy Conservation and Technology Department of the Ministry of Housing, Rural and Urban Development* [2010] No. 17**	The policy is to establish and improve the dynamic energy consumption monitoring system, expand the scope of monitoring, set energy consumption quotas and charge for excessive use and pilot EPC projects.	Pilot EPC projects to promote EPC development
Main Points on 2010 Industrial Energy Saving and Comprehensive Utilization [2010] No. 188	Explore ways to promote new energy-saving mechanism; Continue to study and explore the promotion of new energy-saving mechanism and EPC mechanism for small and medium-	EPC is promoted in public organizations, industrial areas, civilian buildings and other fields, which means EPC will be promoted nationwide in the 11th

	sized enterprises. The local industry authorities encourage voluntary energy system upgrade, promote relevant experience and successful practices of EPC and power demand side management and energy-saving mechanism.	five-year plan period.
***Notice of the Ministry of Housing and Rural and Urban Development on Energy Management in Government and Public Buildings* [2010] No. 90**	Explore EPC and other energy-saving service mechanisms; promote energy conservation in public and government buildings; an energy consumption monitoring platform has been built for pilot cities in Beijing, Tianjin, and Shenzhen; study to promote the EPC implementation, and make EPC in the building field clear.	Energy-saving service mechanism is mentioned to encourage EPC for government offices and large public buildings, and carry out pilot work in future.
***Notice of the State Council on Promulgation of the NDRC's Opinion on Promoting EPC to Support the Energy Service Industry* [2010] 25**	The policy emphasizes the significance of EPC and the energy service industry and proposes the guidelines, principles and development goals for the industry. Besides, it also proposes policy measures to support the development of the energy service industry.	There are some difficulties for energy services industry, such as lack of fiscal and taxation support policies, financing problems, as well as small scale, and absence of unified standards. The policy put forward a series of policies and measures to support the energy services industry, including increasing financial support, formulating tax support policy, improving the relevant accounting system, and further improving financial services, and so on. It's an important document for EPC. China will continue to encourage support for the development of the energy services industry in the coming years. EPC in China will develop in large-scale with the continuous improvement of a series of policies.
***Technical Principles for Energy Management Contract* GB / T 24915-2010**	The document provides the terms and definitions of EPC, technical requirements and contract template. The standard is formally implemented from January 1, 2011.	It is the first national standard of energy services in China, which indicates that energy service market is increasingly standardized.
The Ministry of Finance and NDRC's Interim Policy on Administration of Rewards for EPC Projects [2010] No. 249	Determine the object and scope of the financial support of the incentive funds, support conditions, support methods and award criteria, applications for funding and disbursement method, supervision management and disposal method. A one-time reward is granted to EPC projects based on annual energy savings.	In accordance with the requirements of No. 25, a series of policies to promote EPC has been issued. The state allocates a fund from its fiscal budget to support EPC development
***Additional Notice of the General Offices of NDRC and MOF on Incentives for EPC Projects* [2010] No. 2528**	The document specifies the projects qualified for the incentives	Additional explanation about fiscal incentives

***[The Ministry of Finance and the State Administration of Taxation on the Promotion of the Energy Service Industry through VAT, Business Tax and Enterprise Income Tax Policy](#)* [2010] No. 110**	The policy deals with VAT, business tax and corporate income tax issues related to energy service companies	The tax authorities have also introduced corresponding tax policies.
	Support market expansion and business model innovation, and implement EPC and new business models actively.	Bring EPC into the development strategy for emerging industries.
***Notice on Promoting Energy Conservation in Public Buildngs* [2011] No. 207**	Promote energy efficiency transaction, EPC and other energy-saving mechanism innovation; promote EPC in public buildings; strengthen third-party energy audit and energy efficiency evaluation; make full use of the existing energy monitoring system and establish an energy efficiency evaluation system; encourage EPC in areas that energy-saving effect is obvious, and provide subsidies in accordance with the appropriate policies.	Promote EPC for public buildings' energy-saving efforts, and conduct objective audit and evaluation of disputed energy savings.
The Comprehensive Plan on Energy Conservation and Emissions Reduction in the 12th Five-Year Plan Period [2011] No. 26	Extend market mechanism to promote energy conservation and emissions reduction; accelerate the implementation of EPC; implement taxation and financial support policies to guide the professional ESCO to energy conservation, support the growth of energy services industry; establish an energy saving audit and trade system for EPC projects; develop third-party audit agencies; encourage large energy users to use their own technological advantages and management experience to establish a specialized ESCO; guide and support the various types of financing security institutions to provide risk-sharing services.	Propose new energy-saving targets in the 12th five-yea plan period; guide EPC development; develop a third-party audit agencies; encourage establishing specialized ESCO in the next five-year plan period; provide financial support.
Notice of the State Council on the Issuance of the Energy Saving and Environmental Protection Industry Development in the 12th Five-year Plan Period " [2012] 19	Propose service model innovation; further implement EPC, energy saving and environmental protection services as a new mechanism; promote energy saving and environmental protection facilities construction, and operation of social, market-oriented, professional energy service system; propose the following objectives: the EPC industry average annual sales growth rate will reach 30percent by 2015, with 20 and 50 specialized EPC and environmental protection service company whose annual output value can reach RMB one billion.	Propose market-oriented development of EPC as target for the first time.
The State Council issued the energy saving "12th Five-Year Plan"[2012]	EPC is included in key projects of energy saving, to encourage large energy users to use their technological advantages and	Propose that public institutions should choose EPC as the first option to upgrade their energy system. In

No.40)	management experience to establish specialized ESCOs; support key energy users to resort to EPC for energy system transition; energy conservation for public organizations should be the priority for EPC; strengthen financing support for EPC, encourage banks and other financial institutions to provide flexible financial services for EPC projects; develop third-party certification and the rating agencies. By 2015, energy-saving service system will be in place; there are more than 2,000 ESCOs, and 20 leading enterprises; energy conservation service industry output value can reach RMB 300 billion, employing 500,000 people.	order to solve the financing problem of EPC, banks are encouraged to provide more flexible financial services. A more specific target is set for the energy service industry.
State Council on the issuance of the development of the service industry in"12th Five-Year Plan"[2012] No. 62)	Make EPC companies more professional and stronger; support the growth of a number of professional energy company;guide technology research and development, investment and financing institutions; innovate energy-saving form and content; promote the transformation and application of energy-saving and technological achievements; standardize energy market order, and establish vocational qualification system and credit rewarding and punishing system. In the 12th five-year plan period, average annual sales growth for the energy-saving service industry is expected to reach 30percent by 2015, with the energy service industry's output exceeding RMB 300 billion and the environmental protection industry's output surpassing RMB 500 billion.	Energy service companies are provided with more specific direction; support the growth of a number of professional energy company ".
Notice on Promulgation of the Specific Plan for Energy Conservation in Buildings in the 12th Five-year Plan Period [2012] No. 72)	Encourage EPC and other finance models to support renewable energy application in buildings, which is incorporated as key tasks in the "12th Five-Year" period; accelerate the formation of building energy efficiency and green building market mechanism; promote EPC; standardize energy services; state funds are used to support specialized ESCO to provide users with energy-saving diagnosis, design, financing, upgrade, operation and management in a one-stop solution; provide energy conservation transition for the country and government office buildings, large public buildings, public facilities and schools; develop energy service capacity; promote EPC in energy efficiency improvement; introduce and cultivate professional services management company; develop third party energy audit and energy consumption evaluation; make full use	Summarize EPC development since the 11th five-year plan, and EPC will facilitate building of an energy efficiency society in the next stage of China's development.

	of the existing energy monitoring system and build energy saving evaluation system, as well as objective audit and evaluation of energy savings. For those basic transition with long payback period, fiscal subsidy should be used o promote transformation.	
Notice of the State Council on Promulgation of the NDRC and Ministry of Housing and Rural and Urban Development's Green Action Plan (2013) No.1	Promote public building's energy conservation and transition; upgrade the energy system of large public building and public organization's office building, air conditioning, heating, ventilation, lighting, hot water and other system; strengthen energy reduction and management; the projects that are upgraded through EPC will be rewarded according to the amount of energy saved	Document No. 1 of 2013 is about energy conservation in buildings, which are encouraged to follow the EPC method to upgrade their energy system.