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White Paper: Unleashing Energy Efficiency Retrofits Through Energy Performance Contracts in China and the United States

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Energy Technologies Area

In Cooperation With

ESCO Committee of China Energy Conservation Association (EMCA)

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UNLEASHING ENERGY EFFICIENCY RETROFITS THROUGH ENERGY PERFORMANCE CONTRACTS IN CHINA AND THE UNITED STATES

By

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Executive Summary

Energy performance contracting (EPC) is a mechanism that uses private sector investment and expertise to deploy energy efficiency retrofits in buildings, industries, and other types of facilities. China and the United States both have large, growing EPC markets. This White Paper shares key insights on each market, including strengths and barriers inherent to these markets, compares the two markets, and sets forth options for enhancing EPC markets in each country. The White Paper concludes with recommendations structured around common goals of both countries.

In China, the EPC concept was introduced in 1998 by an international cooperation project called the World Bank/Global Environment Facility *China Energy Conservation Promotion Project*. Since then, China's Energy Service Company (ESCO) industry has expanded rapidly, both in terms of the number of new ESCOs entering the market and amount of capital invested in EPC projects. Despite rapid growth in China, the ESCO sector is still at an early stage of development. Most of China's ESCOs are relatively new and small in terms of assets and working capital. Since its establishment, China's ESCO industry has focused on the industrial sector because that sector dominates the country's energy consumption, accounting for over two-thirds of China's total energy use. Despite the existence of several EPC models in China, the shared savings model has become the preferred model for ESCOs, in part because shared savings projects benefit from government incentives and tax advantages. Moreover, in a booming economy with low energy prices, many industrial enterprises are less interested in investing in energy efficiency, which reduces operational costs, than in revenue-generating production expansion. Due to lack of interest in energy efficiency and understanding of EPCs, ESCOs have to market their services to industrial enterprises by bearing the burden of acquiring capital and sharing savings with industrial customers in order to secure projects. This has placed tremendous financial pressure on China's ESCOs.

While third-party financing is increasingly available for EPC projects of state-owned industrial enterprises, most small-to-medium sized Chinese ESCOs with limited credit histories finance the majority of EPCs using their limited working capital, which contributes to the typically small size of projects. China has made an effort to standardize EPC contracting procedures and to create national standards for monitoring and verification (M&V) of energy savings. These efforts, however, have focused their attention on shared savings contracts. Compared with the industrial sector, which has a strong need for retrofits due to government energy-saving targets, ESCOs in China undertake a significant number of projects in the commercial buildings sector and almost no projects in the public buildings sector. Complications in the chain of building ownership and flat fee-based property management schemes create disincentives for carrying out EPC projects in commercial buildings. And due to smaller scale of each project, the investment in these sectors is comparably small. For the public sector, the government currently allocates an energy budget to public organizations in China based on their prior year's actual expenses. This practice of encouraging energy spending to be comparable to the prior year, along with restrictive accounting rules for Chinese public organizations, makes it difficult for ESCOs to implement

EPC projects in public sector facilities even though the government is promoting EPCs in the public sector.[1]

In China's initial stage of ESCO development, the shared savings model has played an important role in cultivating ESCO industry growth. However, the approach, in the long term, could create greater financial challenges for the EPC market as much of the "low-hanging fruit" has been implemented and ESCOs reach the limit of their working capital. This underscores an emerging opportunity to aggressively pursue alternative EPC financing and contracting approaches that require new policies to support innovation in business models, financing arrangements, and expansion into untapped sectors. It is expected that China's ESCO market will continue to expand, and there are opportunities to further increase the growth of China's ESCO industry. The government plans to replace the ESCO registration requirement with the adoption of a negative list. This move may open up new regional markets for ESCOs, which in the past have been more or less geographically confined.[2] China's Green Building Action Program sets targets for energy-savings retrofits; likewise, overall growing interest in making buildings greener will help increase the number of buildings certified as "green" buildings, increasing demand for deep energy savings retrofits in buildings. Enhanced efforts to create large-scale, real-time energy use monitoring schemes for factories and buildings will help identify more energy-saving opportunities. Benchmarking based on real-time energy use monitoring may help spur energy efficiency retrofits in factories as well as commercial and institutional buildings. National and local programs that allow performance-based contracting in the public sector could further expand China's ESCO market. Increases in market energy prices, adoption of a total energy consumption cap, and establishment of emissions charges may also stimulate the demand for deep energy savings in China.

The United States (U.S.) EPC industry began in the 1980s. Initially, the market was small and focused primarily on utility programs. The first agreements linking payment to performance were shared savings contracts, where the ESCO financed the investment, and both the customer and ESCO shared the value of the savings. In time, particularly as the federal government became a more important client for EPCs, ESCOs found it difficult to continue financing projects from their own working capital. This limited how many new projects they could embark upon. Also, projects could be challenging to monitor and verify as each party had a very strong financial interest in what share of the savings to attribute to EPC measures versus other factors, such as weather or operating conditions. Eventually, ESCOs introduced a new contract mechanism called guaranteed savings, in which the ESCO guaranteed a minimum level of savings that will be sufficient to finance the full upfront cost of the project. This led to predictable payment schedules, which, in turn, also made external financing for the customer easier to arrange. The investments were no longer on the ESCOs balance sheet, which freed up ESCOs' working capital and allowed ESCOs to initiate many new projects. At the same time, the U.S. Department of Energy and the industry worked together to develop an M&V protocol to provide clarity in assessing and documenting energy savings even when conditions changed after a project started. This protocol, the International Performance Measurement and Verification Protocol (IPMVP), made customers more confident in the savings and helped gain the confidence of financiers.

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[1] The Chinese Government Offices Administration of the State Council, in its 2014 work plan on energy efficiency for public institutions, has encouraged public institutions to use EPC in energy efficiency retrofits (http://ecpi.ggj.gov.cn/tzgg/201402/t20140213_284847.htm).

[2] According to recent news, NDRC will remove the ESCO registration requirement and replace it with a negative list system (http://www.china-esi.com/News/45514.html).

Over time, the government and institutional players became the dominant clients of EPCs, largely because of targets that federal, state, and local governments set for energy savings in their buildings. Today, the federal and institutional markets account for 84% of EPCs. Where EPC markets are largest in the United States there are strong energy saving targets, for example, those of the federal government or state governments such as New York. The United States still has many opportunities for growth. These include near-term opportunities in the government and institutional sector, for example, as more states and local governments strengthen their internal energy efficiency requirements and change procurement rules to facilitate EPCs. The United States also has emerging opportunities to expand EPCs in the industrial sector as well as in residential and commercial buildings.

While it can be difficult to compare market size directly because of differences in definitions and methodologies, China's market has grown rapidly in recent years. In 2011, China's EPC market was worth about $6.4 billion, while the U.S. market was worth about $6.3 billion. By 2013, China's market had grown to $12 billion in terms of EPC investments, to a large extent because of significant government incentives for shared savings contracts[3]; the U.S. market in 2013 was worth $7.6 billion.[4] A major driver in the U.S. market has been government and institutional commitments to improve energy efficiency, combined with private sector willingness to adapt contract models and provide financing. In the United States, most projects are between $2 million and $15 million with an average term of 10-20 years, while in China, average size of projects tends to be between $100,000 and $1 million with an average term of 4-8 years. The Chinese government promotes shared savings contracts through offering tax benefits and cash awards to ESCOs; in the U.S., guaranteed savings are the most common type of contract for EPCs and the market has shown quite a bit of adaptation and diversity over time. China has also experienced much change in its market in the past 3-5 years as shared savings has grown in popularity along with energy savings agreements (otherwise known as chauffage). In China, projects typically focus on industrial system upgrades with specialized measures that are more or less independent of each other, while U.S. projects tend to focus on building retrofits and involve multiple, integrated measures; particularly once "low-hanging fruit" are taken, projects typically need to involve comprehensive solutions to achieve deep energy savings. This White Paper concludes with the following initial recommendations:

Goal 1: Deepen and expand the ESCO market in each country.

- China: Tremendous opportunities exist to deepen retrofits. Government policy and incentives may consider encouraging contracting models that foster deployment of technology integration and deep retrofits, by including guaranteed savings that encourage greater greenhouse gas emissions reductions.
- China: Consider adopting policy measures to expand its EPCs beyond industry to more building types, which have proven success records for EPCs in many countries, including the United States
- United States: Consider expanding EPCs to new states and untapped markets. It can also seek to find new ways to tap industrial facilities and commercial buildings markets.
- United States: Also consider providing enhanced targets and incentives to promote deep energy savings retrofits and leverage large-scale, market-based financing.

[3] The Chinese market grows rapidly and reaches $15.46 billion in 2014.

[4] In both cases, we have adjusted U.S. ESCO revenues to factor in financing costs for ease of comparison as the Chinese numbers also include ESCO financing costs.

- United States: Residential retrofits are important in both markets. As the United States is developing new business models, further scale-up and credit data development and organization are needed.

Goal 2: Make the market work towards your advantage. Develop financing, credit assessment tools and contract models that attract investment at lower costs in both countries.

- China: Allow tax incentives, rewards, and M&V guidelines to support models other than shared savings, such as guaranteed savings.
    - Encourage dialog between industry, customers, and government rule makers to maximize incentive/subsidy program impact and advantages.
    - Expand M&V guidelines to cover a wider range of project situations; create strategies to make realistic use of government M&V guidelines in meeting contracting obligation.
    - Develop reliable systems for measuring energy savings and creating effective baselines to ease the implementation of deep-retrofit EPCs.
- China: To facilitate third-party financing to host owners, develop a public national credit rating system and necessary standards/criteria for independent audit firms who certify the financial accuracy of host financial statements.
- China: Create diversified and innovative financing vehicles to encourage deeper savings and project aggregation mechanisms to further reduce transaction costs and achieve scale.
- United States: Encourage continued innovation in financing to unleash residential and commercial markets to expand approaches to low-cost project bundling.

Goal 3: Lead through example in the public sector.

- China: Stimulate investment in the public sector by adapting government procurement policy and budgetary procedures to the needs of EPCs.
    - Allow facilities to retain their energy budgets for the entire period of performance to repay contracts.
    - Ensure that procurement policy streamlines EPCs, for example, by explicitly allowing EPCs, and by allowing for 2-stage tendering (i.e., to allow ESCOs to conduct investment grade audits). Consider Super EPCs to further streamline contracting for public facilities.
- United States: Encourage more states to consider EPC-friendly procurement policies; hold consultations with ESCOs on ways to make these smaller markets more attractive to EPCs, given the higher initial transaction costs of working in small markets.

Goal 4: Enhance U.S.-China cooperation to stimulate markets.

- Use pilot projects to test new concepts.
    - Recommend that the pilot include multi-measure retrofits that deliver deep savings and some or all of the following elements: guaranteed savings, more extensive and detailed M&V requirements sufficient to support comprehensive retrofits, as well as third-party financing borne by a special purpose vehicle or host owner.
    - Consult with the EPC Working Group to confirm areas of interest, in particular the focus on buildings (i.e., public buildings, commercial buildings) versus industry.
- Use the EPC Working Group to build mutual understanding and strategies around feasible models for contracting, financing, M&V, and on important policy issues.

摘要

合同能源管理（EPC）是一种利用市场化的资金和技术提升建筑、工业和其他领域能效水平的机制。中美两国合同能源管理的市场都存在较大的发展空间。本报告分析了中美双方市场发展的关键要素， 包括市场优势和挑战，详细比较了两国市场的共同点和不同点，并本着积极推进两国合同能源管理发展的目标，提出初步建议。

合同能源管理初期引入中国源于 1998 年中国政府和世界银行、全球环境基金联合实施的一个国际项目“中国节能促进项目”。从此以后，中国的节能服务产业发展迅猛，无论从节能服务公司的数量还是合同能源管理的投资额来看都呈现出快速发展的态势。尽管如此，但从产业层面看，中国的节能服务产业仍处于初级阶段，大多数节能服务公司都成立时间不长，资产规模和项目资金规模偏小。中国的节能服务产业发展之初就集中在工业领域，主要是因为工业是能源消耗的主要领域，占全国总能耗的三分之二。合同能源管理的模式在中国也不止一种，其中以节能效益分享型为主，部分原因是因为节能效益分享型合同可以享受国家的财政奖励和税收优惠政策。节能服务产业在起步阶段，因为中国正处于经济快速发展而能源价格偏低的市场情景，许多工业企业往往只把提高能效看作是降低成本的手段之一，对企业扩大生产、增加利润影响不大，因此对能效投资缺乏积极性和主动性。在这种情况下，节能服务公司通过利用自有资金进行节能改造并和工业企业分享节能收益的方法，大规模推动了合同能源管理项目的实施，但同时也为节能服务公司带来的巨大融资压力。

相比而言，国有企业的合同能源管理项目容易获得更多的第三方融资，而对中国大多数中小型的节能服务公司而言，因为他们缺少信用记录因为很难获得第三方融资，因此大多数合同能源管理项目只能使用其有限的流动资金金融融资，因此导致项目规模偏小。中国在合同能源管理合同标准化和节能量测量和验证（M&V）的标准上做了很多工作，包括节能效益分享型的合同能源管理合同模版等。相对于工业领域，由于政府有明确的节能目标要求，因此就产业了大量的节能需求，而建筑领域的合同能源管理项目则是数量多规模小，且技术单一，公共机构的合同能源管理项目则是少之又少，主要原因是商业建筑的产权和使用权以及复杂的物业管理模式，使得节能服务公司在商业领域开展合同能源管理项目困难重重。特别是公共建筑，即便政府已经明文鼓励公共领域采用合同能源管理方式进行节能改造，但政府的财政预算制度成为了合同能源管理的障碍，现有的预算是能源费用预算制，节能降耗只能降低部门预算，无法支付节能服务公司实施合同能源管理项目的节能收益。

在中国节能服务产业发展的初期阶段，节能效益分享型的商业模式对行业的快速起步起到了重要作用。然而，随着越来越多的“低成本节能措施”（唾手可得的节能方案）得到实施以及节能服务公司的流动资金被项目占用，以节能服务公司为融资主体的效益分享型模式可能会对合同能源管理市场的可持续壮大带来资金上的巨大挑战。这同时也是个潜在的机会，即积极寻找其他的融资模式和合同机制。这需要新的政策来支持商业模式及融资机制的创新，以及将合同能源管理扩展到目前还没有涉及到的领域。中国未来的节能服务市场还会不断扩大。中国政府以“负面清单制度”取代现

有的节能服务公司备案方式[5]，或将打破节能服务公司获得政府奖励资金的地域限制，从而开启新的区域市场。中国的“绿色建筑行动方案”为建筑节能改造制定了目标，随之而来的对建筑节能和绿色建筑的兴趣也逐渐上升，带动更多的建筑获得“绿色”认证，从而提高了对深入节能改造的需求。工业和建筑领域的能耗在线检测系统建设也将更有助于了解用能状况，挖掘节能潜力，还可帮助用能单位进行能效对标，甄别节能机会。国家和地方政府鼓励公共领域采用合同能源管理机制，将进一步扩大中国的节能服务市场。能源市场价格的不断攀升、制定能源总量控制目标，以及碳和其他污染排放交易市场的建立，这一切都将在中国激发更多的节能改造市场需求。

美国的合同能源管理始于上世纪 80 年代。开始之初，市场规模很小，同样集中于工业领域。第一批合同是节能效益分享型，即节能服务公司对节能改造进行融资，客户和节能服务公司共同分享节能效益。在此之后，尤其是联邦政府成为合同能源管理项目的重要客户后，美国的节能服务公司发现很难继续用自有资金对节能项目进行持续投资，大大限制了很多新项目的实施。同时，节能量测量和验证的也是一种挑战，因为项目的每一个参与方在项目中都有很强的经济利益，特别是要确定项目产生的节能量是来自于实施的节能措施，还是其他因素的影响，如天气或运行条件的改变。最终，美国的节能服务公司引入了新型的合同能源管理模式，即节能量保证型。在这个模式下，节能服务公司担保实现最低程度的节能量，这样一来，项目可产生的最低预期收益是确定的，因此更有助于获得外部融资。节能服务公司的资产负债表上不再有对节能项目的投资，这使得节能服务公司可以开展更多新的项目。与此同时，美国能源部和其它参与方共同制定了节能量测量和验证规范标准，使得项目条件即使在启动后发生变化，也可以为评估和记录项目节能量提供清晰的依据。这个规程，后演变成为《国际节能绩效测量和验证规程》（IPMVP），使客户对节能量更有信心并提高投资方对规避风险的信心。

随着时间的推移，政府和其它公共部门逐渐成为美国合同能源管理市场的主要客户。大部分是因为联邦、州以及地方政府为建筑节能制定了节能目标。今天，联邦和公共领域的合同能源管理项目占总市场份额的 84%。美国合同能源管理市场最强的领域是那些制定了强有力的节能目标的领域，如联邦政府和州级政府（如加州政府）的节能目标。与中国相仿，美国合同能源管理的市场还有许多增长的机会。短期内，随着越来越多的州级和地方政府加强他们内部的能效要求以及改变政府采购的要求，合同能源管理在政府和公共部门还会有发展。同时，美国在扩展工业领域、住宅领域以及商业建筑领域的合同能源管理方面也有许多潜在的机会。

尽管由于定义和统计方法的不同，很难直接对比中美的合同能源管理的市场规模，中国的合同能源管理市场近年来增长迅速。2011 年，中国的合同能源管理市场价值约 64 亿美元，而美国的市场规模约为 63 亿美元。到 2014 年止，按合同能源管理项目投资额度计，中国的市场已增长到 155 亿美元，主要是因为政府对节能效益分享的合同

[5] 根据最近的新闻报道，国家发展和改革委员会将取消节能服务公司备案制，取而代之将建立负面清单制度。(http://www.china-esi.com/News/45514.html）

能源管理的大力激励；2013 年美国的市场规模达 76 亿美元。[6] 美国市场的一大驱动力是政府和公共机构对提高能效的承诺，以及私营部门愿意接受合同能源管理模式并进行融资。美国大多数的项目规模介于 200 万美元到 1500 万美元之间，为期 10 到 20 年。中国同类项目的平均规模介于 10 万美元到 100 万美元，为期 4 到 8 年。中国政府通过向节能服务公司提供税收优惠和财政奖励来促进节能量分享型合同模式的发展。在美国，节能量保证型是大多数合同能源管理项目所采用的模式，而随着时间发展，市场体现出对不同模式的采纳和多样性。中国在过去 3－5 年间也经历了市场的变化，即节能效益分享型逐渐成为普遍的模式，以及节能管理协议（也可称为 chauffage）的发展。在中国，项目普遍侧重于带有具体节能措施的工业技术升级，这些节能措施在一定程度上独立于其他节能措施。美国的项目一般偏向于建筑节能改造，采用多种、一体化的节能措施；尤其是当“唾手可得的节能量”已经被挖掘后，项目普遍采用全面的解决方案来获得更深入的节能量。

这份白皮书在评估了中美两国合同能源管理市场发展情况的基础上，提出了如下的初步建议：

目标 1：深挖各自国家的节能服务（ESCO）市场

- 中国存在巨大的节能改造潜力。政府的政策与激励措施可以考虑鼓励能够有助于技术整合和深层次改造的合同模式，可包括有助于实现更大幅度减少温室气体排放的节能量保证型合同模式。
- 中国可以考虑制定政策，鼓励合同能源管理项目从工业领域扩大到建筑领域。包括美国在内的很多国家已经有很多合同能源管理在建筑领域的成功案例。
- 美国可以考虑在更多的州公共部门推广合同能源管理，并尝试扩展新的市场 。同时，在工业领域和商业建筑市场，美国可以尝试新型模式。
- 美国可以考虑提高目标并加强激励措施，以促进更深层次的节能改造，同时带动大规模的市场化的融资。
- 民用建筑改造在两国都很重要。美国正在开发新型商业模式，但仍然需要扩大规模，开发和管理信用数据。

目标 2：让市场朝有利的方向发展。在两国开发融资、信用评估工具和合同模式，以更低的成本吸引投资

- 中国：考虑将税收优惠、财政奖励及测量与验证规范延伸到效益分享型以外的模式，包括节能量保证型模式。
    - 鼓励企业、客户、与政府决策者之间的互动，使激励与补贴政策的作用最大化及影响最优化。
    - 扩大测量与验证规范的覆盖范围，使其覆盖更广泛的项目类型。通过有效手段使政府的测量与验证规范可以满足多种类型合同的实际要求。
    - 开发可靠的手段以测量节能量，建立有效的基准线以有利于实施深度节能。

[6] 美国数据是经调整的数据。为了便于中美市场的对比，我们调整了美国节能服务公司的收入，以体现融资成本。因为中国的收入包含了节能服务公司的融资成本。

- 中国： 加大第三方金融投资机构对业主单位的融资，开发全国公用信用等级系统和必要的标准、准则，让独立的审计公司可以借此认定业主单位财务报告的准确性。
- 中国：建立多样的和创新的融资渠道以鼓励产生更多的节能量；建立项目打捆机制以降低交易成本，扩大规模。
- 美国：持续鼓励金融创新，以打开民用与商业建筑市场，扩大低成本项目集成。

目标 3：在公共部门建立合同能源管理样板

- 中国：根据合同能源管理的需要调整政府采购政策与能源费用预算制度，以带动向公共部门的能效投资。
  - 允许公共部门在整个项目实施期间保留原有能源预算，以偿付节能项目合同款项。
  - 保证采购政策有利于合同能源管理项目，例如，明确地允许合同能源管理模式，并允许两阶段招投标（即允许节能服务公司进行投资级别审计）。考虑建立“超级合同能源管理”以优化公共部门的合同流程。
- 美国：鼓励更多的州采用有利于合同能源管理项目的采购政策。由于在小规模市场的初始交易成本比较高，鼓励与节能服务公司开展咨询以利于这些小规模市场更加吸引合同能源管理项目。

目标 4：加强中美合作，推动双方市场发展

- 通过示范项目探索新概念。
  - 建议示范项目包括技术整合方案，实现深度节能。同时采用下列方式，包括：节能量保证型的应用，更有效支撑技术整合的测量与验证手段，以及第三方融资模式。
  - 与合同能源管理合作项目工作组共同研究，确立方向，特别是确定项目选择是侧重于建筑领域（公共建筑，商业建筑等）还是工业领域。
- 利用工作组推进双方的合作共识，包括建立可行的合同、融资、测量与验证以及重要政策建议等战略问题。

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Acronyms and Abbreviations

ADB	Asian Development Bank
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
Btu	British Thermal Unit
CHUEE	China Utility-Based Energy Efficiency Finance Program
CNY	Currency of China Yuan
CUPIC	China United Property Insurance Company Limited
DOE	U.S. Department of Energy
EMC	Energy Management Company
EMCA	ESCO Committee of China Energy Conservation Association
ESCO	Energy Service Company
EPC	Energy Performance Contract
ESPC	Energy Savings Performance Contract
FEDS	Facility Energy Decision System
FEMP	Federal Energy Management Program
FYP	Five-Year Plan (China)
GDP	Gross Domestic Product
GEF	Global Environmental Facility
HVAC	Heating, Ventilation and Air Conditioning
IFC	International Finance Corporation
IPMVP	International Performance Measurement and Verification Protocol
LBNL	Lawrence Berkeley National Laboratory
LEED	Leadership in Energy & Environmental Design
M&V	Measurement and Verification
MOF	Ministry of Finance (China)
MUSH	Municipal, University, School and Hospital
NAESCO	National Association of Energy Service Companies
NDRC	National Development & Reform Commission (China)
PACE	Property Assessed Clean Energy
PNNL	Pacific Northwest National Laboratory
SME	Small-to-Medium Enterprises
tce	Ton of Coal Equivalent
USD	U.S. Dollar
WB	World Bank
WHEEL	Warehouse for Energy Efficiency Loans

Introduction

Both the United States and China seek opportunities to improve energy efficiency domestically. Energy performance contracts (EPCs) have changed the market for energy efficiency because of the ways that they integrate many of the elements of an energy efficiency project (including design, construction, financing and monitoring) into a single contract. The companies that implement EPCs are called energy service companies (ESCOs) in the United States and energy management companies (EMCs) in China (in this paper, we use the terms interchangeably). However, there are significant differences in the EPC mechanisms and markets in each country. This paper will explore these differences and provide insights on options for expanding the EPC markets in both countries based on best practices in each market. EPCs are important in unlocking financing and technical know-how for energy efficiency. Improving the efficiency of existing facilities, production processes, and systems is important in reducing emissions and energy costs, and improving economic efficiency.

Current Market in China

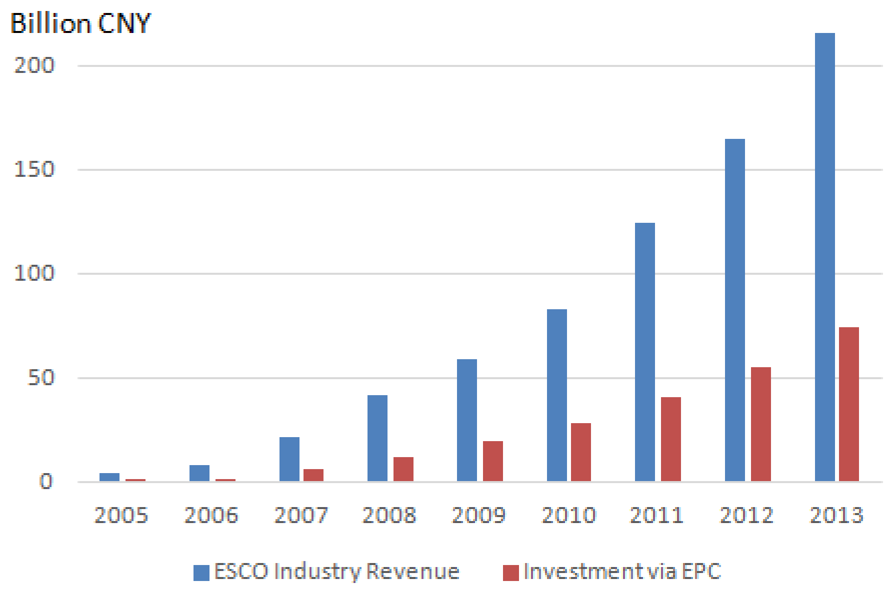
Background

The concept of providing energy-saving services through contracting by an ESCO was introduced to China at a time when energy and climate change had become a global issue and China's energy supply and demand imbalance was increasing rapidly, largely due to inefficient use of energy in its economy. EPCs were introduced to China in 1998 by the China Energy Conservation Promotion Project of the World Bank/Global Environment Facility (WB/GEF). The project piloted the concept of EPC in China through creation of three local ESCOs, whose primary business was to gain revenues through EPC. The WB/GEF project also focused on enhancing the capacity of China's ESCO industry by providing loan guarantees to ESCOs as well as establishing the ESCO Committee of China Energy Conservation Association (EMCA) as the industry association for ESCOs in 2003 (Taylor et al. 2008).

ESCO and EPC Market

During the past years, China's ESCO industry expanded rapidly, both in terms of the number of new ESCOs entering the market and amount of capital invested in EPC projects. Figure 1 (below) shows total ESCO industry revenue and the amount of investments made through EPC projects from 2005 through 2013. The total revenue shown includes revenues from both EPC and non-EPC projects. Statistically, China's ESCO market size seems to be much larger compared to that of the United States. China's statistics are based on total investment volume, which goes beyond the equity invested by ESCOs to include the financing received by ESCOs, performance-period services, and M&V services. U.S. statistics are based on total EPC revenue reported by ESCOs, which is only a portion of the total project cost (e.g. financing costs do not accrue to the ESCO in the United States). (Table 11 compares the U.S. and Chinese EPC investments and is adjusted to account for these different measurement approaches).

Figure 1. China ESCO Industry Total Revenue and EPC Investments, 2005-2013



Sources: EMCA & IFC 2012; GBPN 2013; CESI 2014

Despite rapid growth in China, the ESCO sector is still in an early stage of development. Almost half of the ESCOs registered with China's National Development & Reform Commission (NDRC)[1] were established in 2010 and 2011 and most registered ESCOs were established within the past 5 years but are not necessarily operating. According to EMCA's most recent survey, as of 2013, there were 4,852 ESCOs conducting energy service businesses, among which 3,210 are registered with NDRC. In 2013, the total output of China's energy service industry reached CNY 215 billion ($36 billion[2]) and investment in EPCs reached CNY 74 billion ($12 billion) (EMCA 2014). Most of China's ESCOs are not only young but are also small in terms of assets and working capital. More detailed information about China's ESCOs is provided in Appendix D.

There is an imbalance in investment between China's small and large ESCOs. According to EMCA's analysis its 2014 survey data, 1,866 ESCOs reported a total investment amount of CNY 26.39 billion ($4.4 billion). Roughly half of the total investment is from less than 5% of registered ESCOs. Thirty five percent of the investment is from just 34 companies, or 0.7% of registered ESCOs.

EPC Targeted Sectors

EMCA's 2012 ESCO industry survey collected data on and analyzed a total of 874 EPC projects that were implemented between 2010 and 2011. Among these projects, the majority was in the industrial sector, followed by the buildings and the transportation sectors, respectively. The average contract size for projects in the industrial sector was almost three times larger than in the buildings sector.

Table 1 shows the average EPC contract size in each sector and the respective shares during

[1] The National Development & Reform Commission (NDRC) requires that ESCOs be registered with NDRC in order to be qualified for Ministry of Finance's energy-saving project incentives offered to ESCOs. Details about this incentive are discussed later in this White Paper.
[2] This paper uses a currency conversion rate of 6:1 to convert CNY to USD.

2010–2011 (EMCA & IFC 2012).

In 2013, the share of total industry sector contracts decreased to 72%, while building and transportation sectors increased to 21% and 7%, respectively (EMCA 2014). For industry projects, major services include use of waste heat and pressure, motor system upgrades, and industrial boiler and furnace retrofits. For the building sector, there is growing attention to distributed energy, urban centralized heating, lighting, as well as heating, ventilation, and air conditioning (HVAC) retrofits.

Table 1. Average EPC Contract Size in Each Sector and Sectoral Share in Total, 2010-2011

Sector	Average Contract Size (CNY million)	Share of Total Contracts
Building	6.02	15%
Industry	16.53	82%
Transportation	12.58	3%

Source*:* EMCA & IFC 2012

Contracting Models

Currently, there are three types of contracting arrangements for EPCs in China that are documented in the EMCA ESCO survey: shared savings, guaranteed savings, and outsourcing of energy management (otherwise known as chauffage). The definition of these three models is provided in Appendix D. According to EMCA (Sun 2014), the length of the shared saving contracts ranges from 4 to 8 years with some longer than 20 years. EMCA does not specify the exact length of a typical guaranteed savings contract, but indicates that its term is typically short and it is usually used when ESCOs do not have sufficient project funding and thus prefer fast payment from the host. For the outsourcing model, the typical contract length ranges from 8 to 12 years. Table 2 below shows the respective shares of the three contracting types in EPC projects for four time periods. The large market share of the shared savings approach can be directly correlated to the government support policy that was adopted since 2010, which favors this model (see policy section below).

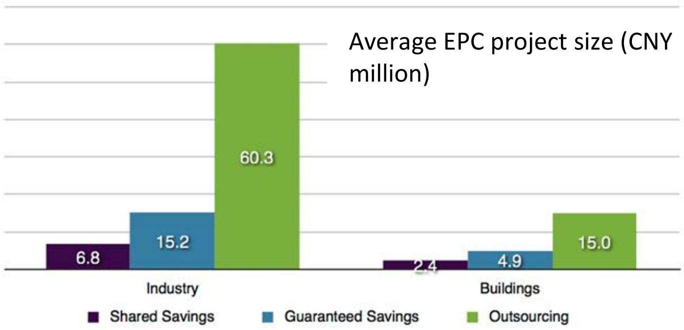
Table 2. Shares of the Three Contracting Models in EPC Projects

Year	Shared Savings	Guaranteed Savings	Outsourcing	Other*
2007-2009	61%	36%	NA	NA
2010-2011	66%	20%	6%	8%
2012	47%	44%	4%	5%
2013	45%	42%	6%	7%

*Any contracting other than the three types is categorized as other, which is not specified by EMCA surveys.
Sources: EMCA & IFC 2012; EMCA 2014

Although updated information is not available from public sources, EMCA member surveys from 2007 to 2009 provide information on the use of the three contracting models in the industrial and buildings sectors. In industry, 54% of total projects used shared savings contracts, while 46% used guaranteed savings contracts, and about 70% of the buildings retrofit projects used the shared savings model. In both buildings and industry sectors, smaller projects tend to use the shared savings model, while medium- and large-sized projects relied heavily on the use of the guaranteed savings and outsourcing models, respectively (see Figure 2).

Figure 2. Average Size of EPC Projects by EMCA Members, 2007-2009



Source: Sun et al. 2011

ESCO Technologies

ESCOs in China focus primarily on two main markets: industry and commercial buildings. Industrial projects are generally equipment-focused, including boiler renovations, technology upgrades in combustion systems, renovations of kilns and furnaces, waste heat or gas recovery, motor-drive system renovations, cooling system replacements, internal power supply renovations, and automatic control systems. Commercial building projects focus primarily on lighting retrofits and HVAC system renovations and innovations. In both cases, the projects tend to focus on a few, more selected technologies. Lack of expertise in energy efficiency opportunities commonly exists in energy users—especially public entities like schools and hospitals (EMCA & IFC 2012).

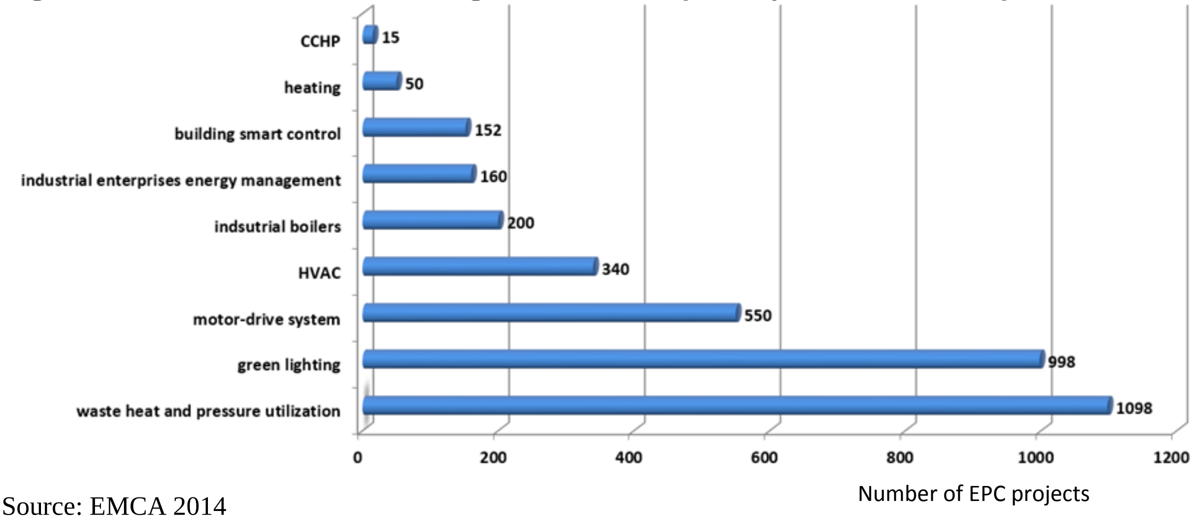
Figure 3 shows the number of EPC projects in major technologies in 2013. According to EMCA, investments in these technologies will continue to expand in the future, with additional technologies also being employed (EMCA 2014).

Why is Shared Savings a Preferred Model in China?

In its early development, ESCOs in China, especially smaller ones, had no other choice than the shared savings model. With a booming economy and low energy prices, many enterprises were less interested in energy efficiency. The pursuit of energy efficiency was further constrained by competing for internal capital needed for production expansion. With the lack of interest among enterprises in energy efficiency and understanding about EPC, China's ESCOs have to market themselves by shouldering the burden to acquire capital and share the savings with host enterprises in order to secure projects. This is the primary factor that has made the shared savings model—with the ESCO's bearing both technical and credit risk—the predominant model today in China.

The shared savings model has, however, placed tremendous financial pressure on ESCOs, limiting their ability to take on deep retrofits. Significant financial rewards and tax benefits are offered by the Chinese central and local governments (see policy support section) to ease the financial difficulties that ESCOs face and to lift up the EPC market. With the improved capacity of China's ESCOs, as well as increased interests in energy efficiency in Chinese society due to rising energy costs and growing needs for meeting mandatory energy and environmental Five Year Plan targets in all sectors, ESCOs in China will expand their offerings and increase the use of other options including the guaranteed savings approach.

Figure 3. Distribution of Technologies in EPC Projects by Number of Projects, 2013



Source: EMCA 2014

ESCO Financing and Mechanisms of Reducing Financial Risks

Third-party financing is increasingly available for EPC projects with large ESCOs. In China, the predominant form of third-party financing is debt financing in the form of bank loans. However, these loans represented merely one-fifth of total EPC project funding in 2011 and only a small portion of ESCOs (18%) had access to bank loans with 36 companies (or 2% of all surveyed ESCOs) borrowing over 65% of the loans lent to ESCOs in 2011. In other words, Chinese ESCOs themselves finance the majority of EPCs using their limited working capital, which is one of the reasons for the small project sizes. To increase the number of options for financing EPCs, China adopted or is experimenting with other financing options, but at a negligible scale. These options include leasing financing; private equity financing; financing via the public market; lines of credit; an ESCO industry development fund; financing via revolving international donor agency loan; and EPC trading (forfeiting). Table 3 lists various types of financing options currently used in China.

Table 3. Types of EPC Financing in China

Types	Funding Sources	Examples/Notes
Bank loan	Commercial banks	Bank of Beijing, Shanghai Pudong Development Bank, Everbright Bank, Xingye (Industrial) Bank, Bank of Communications, Huaxia Bank, Pingan Bank, and Agricultural Bank all have loan programs for EPC. Among these banks, Bank of Beijing, Shanghai Pudong Development Bank, and Xingye (Industrial) Bank allow ESCOs to use receivable-based financing from future savings as collateral. Xingye (Industrial) Bank has standardized its EPC lending practices. Bank of Beijing, Shanghai Pudong Development Bank and Xingye Bank supported more than 300 ESCOs for about 500 EPC projects and financed over CNY 5 billion loans in 2013. International donor agencies, such as the World Bank and French Development Agency, have created various energy efficiency lending programs using domestic financial intermediaries (DFIs) in China, which in turn lend the international donor agencies' funds along with

		loans committed from their own resources.
Private equity financing	Venture capital (VC) and private equity (PE) firms	Funding levels for EPC from VC or PE are not clear; but investment through VC and PE accounted only for 2.2% of China's total clean energy investment in 2010. New Three Board is a financing service platform created jointly by various Chinese entities to allow non-public-listed, small-and-medium-sized innovation companies to conduct equity trading. Participating in this platform helps enhance companies' credit and thus facilitate their financing.
Public equity financing	Individual and institutional investors	Top Resource Conservation Engineering Co., Ltd became the first ESCO IPO company focusing on EPC in China. Two other Chinese ESCOs have also gone public: Tianhao Energy Saving Technologies, Inc. in 2012 and Beijing Shenwu Environmental and Energy Technology, Inc. in 2014. Shenzhen Coolead Industry Co., Ltd is the first Chinese ESCO to issue private bonds through the Shenzhen Stock Exchange. More than 80 listed companies have an EPC business.
Lease financing	Equipment leasing companies	ESCOs increasingly work with lease companies to secure financing. In 2013, Jiuyuan Tianneng and Xingye Leasing collaborated on CNY 170 million lease financing. Other examples include Hangtian Dongyi and CIC leasing company, Peieryou and Xinda Leasing Company, and Zhineng Xiangying and Zhongguancun Leasing.
Special bank programs	Commercial banks	The Bank of Beijing announced in April 2011 that it signed a strategic collaboration agreement with EMCA to provide its member companies with a special line of credit of CNY 10 billion ($1.6 billion) for five years. Shanghai Pudong Development Bank has signed agreements to place 10 billion CNY for ESCO business loans.
ESCO Industry Development Fund	Local government and private funds	Shanghai Economic & Information Commission and Shanghai Hongkou District Government are working with private funds to form a public-private partnership by creating a Special Energy and Environmental Industry Development Fund to build an investment pool to promote EPC.
Finance via revolving use of international donor agency financing	Local jurisdiction, International donor agency	Asian Development Bank (ADB) offered a 15-year loan of $100 million with an interest rate of 0.93% to support energy efficiency projects in Hebei Province. The Provincial government applied for the ADB loan to fund projects selected from a pool of pre-screened projects in a 2-year term at a higher rate (10% off the base rate of 6-month commercial loan which is currently about 5.04%). For well-performing projects, excessive interest payments above the ADB rate will be refunded back to the borrower as an incentive. Through revolving use of ADB funds, Hebei is able to enlarge the size of ADB financing.
EPC trading/ factoring/forfeiting	Environmental exchanges	Factoring/forfeiting is a type of debt financing in which a business sells its accounts receivable to a third party (called a factor or a forfeiter) at a discount to secure financing. Beijing Environmental Exchange announced the establishment of an EPC investment and financing

trading platform on June 5, 2010 to collaborate with EMCA in creating a centralized system for investors, ESCOs, and customers and allowing EMCA member companies to trade their EPCs as a tradable product through the system. Such a trading mechanism allows a third-party entity (e.g., banks) to buy the future receivables from the EPC at a discount, paying the ESCO as soon as the project is completed.

Sources: EMCA 2014; Chen 2014; Liu 2013; Shen et al. 2013

In recent years, efforts have been made in China to address risks associated with financing, especially with the help of international agencies. The World Bank/GEF China's Energy Conservation Promotion Project includes a loan guarantee program requiring 100% collateral. China's largest guarantee company, the China National Investment & Guaranty Co. (I&G), uses a $26 million GEF grant held by the Government of China as a reserve and guarantee to cover potential default (Zhou 2011). As an important component of the International Finance Corporation (IFC) China Utility-Based Energy Efficiency Finance Program (CHUEE), IFC is cooperating with Chinese commercial banks to offer a risk-sharing facility under which IFC bears a certain portion of the loss for all loans made by Chinese banks within the energy efficiency financing portfolio. An independent evaluation of the CHUEE program found that the rate of obtaining bank financing increased by 31% for members in the CHUEE-supported ESCO network (Independent Evaluation Group 2010).

On a smaller scale, China's fourth largest insurer in terms of insurance volume (China United Property Insurance Company Limited, CUPIC) has recently started offering a new product called energy performance guarantee insurance, which involves four parties: the ESCO, the host, CUPIC, and a lender. Under a special arrangement, the ESCO signs an energy-saving guarantee agreement with a host for a minimum savings level and helps arrange financing for the host to take out. The amount financed will cover the costs of equipment installed, the insurance premium, and a mark-up for the ESCO. As the borrower, the host is responsible for repaying the loan in installments, which are sized based on expected savings. If the ESCO under-performs, CUPIC will pay the host the savings shortfall so that the host can repay the lender (Cao 2014).

Some international financial institutions, including IFC, are exploring the development of energy performance insurance products and facilities, which may serve as innovations that facilitate the unlocking of EPCs at scale. The insurance may also serve as third-party validation of expected savings from measures installed by the ESCO and may engender confidence in such savings for the host company making lease or debt service payments. Large and well capitalized ESCOs may benefit from utilizing performance guarantee insurance products as a way to reduce the level of contingent liabilities counted against their balance sheets, since it is commonly required for publicly traded ESCOs to disclose such contingencies in their financial statements. If scaled, the energy performance guarantee insurance could present benefits for small to medium-sized ESCOs with limited balance sheets backstopping performance guarantees they issue that cover technical risk. As a market for this product grows, the insurance may also prove advantageous in cases where technologies from different manufacturers are installed or where innovative but proven technology that is not yet commercialized is integrated into retrofits by small and specialized ESCOs common in China—such as large-scale, real-time energy use monitoring schemes. As the only financial intermediaries typically staffed with technical and engineering expertise, insurers may be better suited than banks to assess and bear the technical risk for an EPC. In this regard, an EPC's technical risk may be appropriately allocated to the insurer, while allowing the lender to focus on its expertise—namely underwriting the credit risk of the borrower and insurer rather than undertaking a complicated technical analysis of the EPC.

Policy Support and Favorable Tax Treatment

The Government of China has adopted a series of policies to encourage development of the ESCO industry and adoption of EPC. Appendix D provides information on these policies. To support policy implementation, the central government has created incentives that combine cash rewards and favorable tax treatment for eligible ESCOs. Qualified ESCOs are those companies who cover at least 70% of the project investment, complying with the national standard *General Technical Rules for Energy Performance Contracting* (GB/T24915-2010), and sign shared savings EPC with the host according to the standard contracting format.

The reward program targets industrial projects with energy savings achieved between 500 and 10,000 tons of coal equivalent (tce) (18-360 million Btu) and projects in other sectors with energy savings between 100 and 10,000 tce (3.6-360 million Btu). The national government funding for ESCOs is supplemented by incentives from local governments. For every tce of verified energy savings, the provincial governments are required to offer a minimum of CNY 60 ($0.28/thousand Btu) to match the national incentive of CNY 240 ($1.11/thousand Btu) (MOF 2010). Local governments have also provided rewards to support EPC projects. Table 4 lists fiscal rewards offered by local governments in China.

Table 4. Local Fiscal Incentives in Selected Locations

Location	Amount of Incentives (CNY/tce saved)
Beijing	Industry: 600; Buildings and transportation: 800; Chauffage option: 360
Shanghai	600
Shenzhen	540
Guangdong	500
Fujian	Industry: 500; Building & Transportation: 800
Shanxi	400
Tianjin, Hainan, Chongqing	360
Xiamen	340
Xinjiang	240

Source: EMCA 2014

In addition, China's government has provided favorable tax exemptions and reductions to support the ESCO industry in pursuing EPC. In China, ESCOs are normally subject to three types of taxes: value-added tax, business tax, and corporate income tax. Table 5 below shows the tax implications for ESCOs.

Table 5. Types of Tax for ESCOs in China

Type of Tax and Rate	When to Be Imposed
Operational tax – 5%	ESCOs provide energy-saving services
Value-added tax – 17%	An ESCO transfers an asset to the host (which is treated as a sale)
Corporate income tax – 25%	Revenue is generated

The new tax policy allows qualified ESCOs to get a waiver for paying the operational and value-added taxes. Further, the new tax policy gives a full exemption for corporate income tax for shared savings EPC projects carried out by ESCOs in the first three years of generating project revenue, with 50% income tax reduction for up to three additional years. This tax benefit can be transferred to another ESCO when the project is transferred within a valid period. Any fixed or intangible assets can be depreciated or amortized over the shared savings contracting period, creating greater benefits for ESCOs entering into shorter projects, as this creates higher depreciation or amortization, resulting in a reduced tax payment. Other EPC models, however, are not qualified for these special tax treatments. ESCOs are currently required to register with both provincial governments and NDRC in order to receive the government rewards and tax benefit. Local jurisdictions require local registration for eligibility for local incentives and, to an extent, have played a role in fragmenting the market geographically. Recent news reports indicate that NDRC will replace the ESCO registration requirement with a negative list mechanism.[3]

Compared with national incentives, incentives at the local level are more flexible. For example, Beijing municipal government increased the funding level to CNY 800 per tce saved and lowered the incentives threshold to any retrofits saving more than 100 tce for industrial and 50 tce for non-industrial projects. Beijing also encourages the adoption of other contractual models. For example, chauffage that generates savings of 300 tce is qualified for an incentive of CNY 360 per tce of measured savings. In Guangdong, the provincial government has implemented incentives to allure outside ESCOs to carry out EPCs in the province. Cities such as Shanghai allow local ESCOs to register with the local government and receive financial support that otherwise would not be provided from the national government (EMCA 2014).

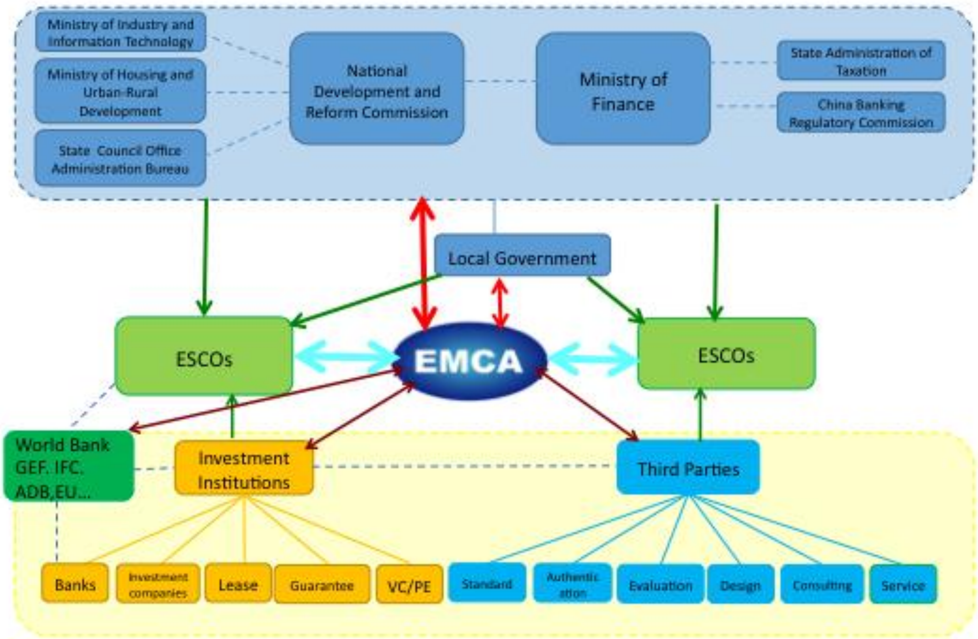
In 2013, 500 ESCOs submitted more than 1,000 EPC projects worth CNY 4 billion of investment for national incentives in 2013 (EMCA 2014).

Institutional Structure

There are many stakeholders in China that play a role in EPC. At the national government level, both NDRC and the Ministry of Finance play a significant role in providing policy and financial support to ESCOs. EMCA is a national association of ESCOs and industrial experts that operates as a sub-association of the China Energy Conservation Association. Since its establishment, EMCA has played a key role in promoting EPC. Its main responsibilities include assisting policymakers in developing and enabling policies; developing training materials and offering training courses to build capacity; organizing workshops to engage decision makers, interested companies, and banks; conducting member surveys and carrying out research to understand key issues facing the industry; convening meetings and holding annual summits to allow members to exchange information and expand business cooperation; and creating partnerships to aggregate resources for its members. Figure 4 below illustrates the institutional framework relative to the ESCO industry in China.

Figure 4. Institutional Framework Related to the ESCO Industry

[3] http://www.china-esi.com/News/45514.html. This move follows the recent trend in China in shifting government governance from pre-approval to post-oversight. It is still unclear on what the negative list requirement will be, and the change requires further examination and study to ascertain its significance and impact on the ESCO industry in China.



Efforts to Standardize Contracts and M&V Protocols

In August 2010, China issued *General Technical Rules for Energy Performance Contracting* (GB/T 24915-2010), which is a recommended national standard. This standard provides a list of defined terms related to EPCs and provides general technical requirements that EPCs need to meet, including energy audits, baseline determination, and measurement and verification. In addition, the standard provides a standardized format and defines the content of EPC contract documents—but only for shared savings projects, which could limit the use of other contracting options, thus missing opportunities for using more flexible options that could result in deep energy savings from comprehensive, multi-technology retrofits.

Regarding measurement and verification (M&V) protocols, China issued *Calculating Methods of Energy Saved for Enterprise* (GB/T 13234-2009) in March 2009. This is a recommended national standard for the estimation of energy savings in enterprises. In August 2013, China issued another recommended national standard on *General Technical Rules for Measurement and Verification of Energy Savings* (GB/T 28750-2012), which provides definitions, the calculation methodology, and standardized practices related to M&V of energy savings. This general technical standard adopts the guiding principles of the International Program Measurement & Verification Protocol (IPMVP). Also in 2013, China began development of a national standard series entitled *Technical Requirements for Measurement and Verification of Energy Savings*. In 2013, two draft standards (for fans and pumps) in this series were released for public comment. In March 2014, six more standards in the series were released for public comment. These six standards cover sheet metal heating systems, residential building heating systems, cement waste heat power generation projects, telecommunication stations, lighting systems, and central air conditioning systems (China Finance 2014). In addition, two more national standards are currently being developed—one is *Energy Savings Measurement Technical Rules-Building Energy Savings Projects* and the other is *Energy Savings Measurement and Verification Implementation Guide* (Wang 2014). While developing these standardized M&V protocols is necessary to ensure the success of EPCs, the lack of a comprehensive protocol that covers multiple systems—and measures and that takes into consideration the interaction of various measures—remains a challenge, especially for deep energy savings projects that often require integrated solutions involving multiple energy conservation measures.

Technical Support

In China, EMCA plays a critical role in providing support for EPCs, including:
1) Establishing platforms to promote ***industry communication***: EMCA organizes conferences and events that bring together key stakeholders to exchange ideas and seek opportunities, such as ESCO manager meetings and executive meetings, the Technology Promotion and Collaboration Forum, the ESCO Financing Forum, China energy savings service field trips, and the Annual ESCO Summit. The ESCO Summit is China's leading event for the industry, which is currently in its tenth year.

2) ***Surveys and research***: EMCA started conducting an annual ESCO survey several years ago to help companies and policymakers better understand the market. EMCA is collecting best practices from member companies to produce an EPC Excellent Project Case Set. Research is also underway on the use of waste heat and pressure, advanced lighting, and financing.

3) ***Capacity building***: EMCA created the China Energy Services Training Center to provide training on a range of topics including policy, financing and financial management, project management, technologies, taxation, energy auditing, and M&V. Training courses for ESCO general managers, financial managers and project managers are also well developed and welcome in the industry. More than 10,000 staff have participated in different types of trainings. Training programs for EPC project managers and for EE M&V programs have been registered as qualification trainings by national authorities.

4) ***Financing services***: EMCA created the China Energy Services Financing and Investment Platform, which is a centralized system connecting investors and ESCOs to increase access to financing. EMCA also created an entrepreneur club as a bridge for financiers and ESCOs to discuss EPC financing.

5) ***International cooperation***: EMCA helps organize and participates in international ECP fora and initiatives, such as the annual US-China Energy Efficiency Forum. Right now EMCA has contacts with relevant associations all over the world, including but not limited to the National Association of Energy Services Companies (NAESCO) and the American Council for an Energy Efficient Economy (ACEEE) in the United States, Alliance to Save Energy in the United States, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH in Germany, Agence Française de Développement (AFD) in France, New Energy and Industrial Technology Development Organization (NEDO) in Japan.

6) Information ***Dissemination platforms***: EMCA's China Energy Service Website, ESCO in China (monthly journal), mobile weekly digest, and new WeChat public account promote information dissemination on industry trends, best practices, technologies, and emerging business models. [4]

Major Barriers

Despite significant efforts made to date, there are still several barriers that impede the development of an even larger market for ESCOs and EPCs in China. Table 6 highlights key

[4] For detailed discussion of EMCA activities and programs, please visit EMCA web-site at: http://www.emca.cn/

barriers that have a major impact in inhibiting market growth in China, particularly in deep energy savings, multi-technology retrofits.

Table 6. Key Barriers to EPC in China

Barrier	Discussion
Lack of access to external financing and shortage of diversified sources of financing	The majority of China's ESCOs are small-to-medium enterprises (SMEs), with limited credit histories and smaller balance sheets that prevent them from accessing much needed capital. The ESCO business is service-based and lacks assets, making it hard to get loans from banks. Most ESCOs in China focus on niche markets with technology solutions that have not yet established a great track of record of success. The lack of diversified and integrated technology offerings from ESCOs coupled with the lack of familiarity that banks have of energy efficiency measures have raised concerns among financiers related to the successful rate of their investments and has increased perceived risks, resulting in less capital availability. The bank-dominated financing structure offers limited financing options that are not commercially attractive or viable for SMEs and most other ESCOs. Sizes and available funding from diversified sources other than bank loans have been small and limited.
Lack of comprehensive M&V protocol and technical and institutional capacity in M&V	Despite the development of standardized national M&V protocols, there is still a lack of a comprehensive protocol in China that takes into consideration the interaction of various energy efficiency measures. This results in difficulty for deep saving projects that often require integrated solutions. There is also a lack of reliable measurement equipment and baseline data to ensure the effectiveness of M&V work in China. In addition, China's M&V work is currently carried out by several dozen authorized institutions that have many other responsibilities. M&V work in China is thus further hindered by the lack of trained independent M&V specialists. China's ESCOs and hosts may lack interest in investing in solid M&V due to the additional cost and may instead stipulate to agreed savings payments. This approach is problematic for attracting third-party investors who do not wish to bear the risk of non-payment if employees of the host who were not involved in the negotiating history question the justification for the savings payments which cannot be verified after the fact.
Lack of creditworthiness	A strong credit system has not been well established in China. As a result, host companies often lack confidence in the ESCO's purported energy savings, while ESCOs are concerned about whether the host will share the savings as agreed upon. Moreover, the gap in standards and criteria for independent financial audits in China raises questions about the reliability of audited financial statements of private hosts, making assessment of the creditworthiness of private hosts difficult. As a result, the market narrows around SOE hosts, which is a difficult market for non-SOE ESCOs to access.
Lack of motivation to pursue EPC models other than shared saving	Existing government incentives favor the shared savings EPC model over other models. However, China's incentive policy requires ESCOs to commit equity to cover at least 70% of the project cost and they get paid only after savings are realized. This to a large extent limits the ability of ESCOs to take on multiple projects and shortens the project delivery time, resulting in a reduced focus on comprehensive retrofits that result in deep energy savings. Since under the shared savings model ESCOs have to take in less cash, thus reducing the amount available for debt repayment, it will in effect require ESCOs to either take longer to repay the debt or borrow less money—which results in shallower

	retrofits.
Lack of standardized contracting procedures for multiple business models	EPC is unique in that it deals with technical services that reduce energy use. Standardized contracting procedures can help minimize disputes. So far, China only has standardized contracting guidelines for the shared savings model. These standards do not require sufficiently detailed and transparent capital cost and savings calculations for M&V purposes to support guaranteed savings projects.
Lack of market consolidation and scale of economy	Individual project developers or ESCOs often carry out energy efficiency projects separately. The many small ESCOs that are important players in China's market typically only undertake small projects making it difficult, if not impossible, to aggregate and develop large clusters of viable projects. Such a lack of project bundling misses opportunities for including more comprehensive deep-energy saving measures in the project portfolio.
Complication of building ownership and operation management	In China, buildings (especially apartments, office buildings, department stores, etc.) have complicated ownership structures with some having dozens or even hundreds of individual owners. This complicated ownership results in difficulties in developing EPC projects. In China, property management companies are hired to manage routine operations in buildings. These companies are generally paid a flat fee determined by the size of the buildings they manage. This flat-fee system makes property management companies less interested in pursuing energy savings.
Lack of public sector involvement as an active EPC customer	China's public sector (governments, schools, colleges, and hospitals) has a significant potential for use of EPC. The Chinese government has adopted policies to promote energy efficiency in public institutions. The Public Sector Energy Conservation Rules issued by State Council in 2008 established specific rules and requirements for the public sector to conserve energy and improve energy use in public institutions. Among many requirements, this directive requires development of a set of energy-use thresholds (i.e., energy use per square meter) based on region and building type, and requires the government financial authority to use these thresholds to determine the allowance for public institutions' payment for energy use. While linking the energy budget with energy use performance is effective in encouraging institutions to conserve energy, it reduces the interest of ESCOs in pursuing EPC since the payment allowance reduces the public institutions' ability to pay ESCOs. The government energy budget in China is included in the government appropriation, which is to be determined by the previous year's actual expenses. This budgetary practice along with restrictive accounting rules for Chinese public organizations has created difficulties for implementing EPC projects in public sector facilities because ESCOs cannot benefit from the cost savings.

Sources: Zhang 2014; Gan 2009; Dreessen 2009; Taylor et al. 2008; Wang 2008

Future Market

Forecast results of ESCO market potential in China are not publicly available. Consequently, we estimate the market size for China's ESCO industry in the next five-year plan (FYP) period on a business-as-usual basis. Our forecast utilizes annual ESCO data released by EMCA between 2007 and 2013 and calculates the historical growth rates of total energy savings achieved by ESCO industry and total invested capital via EPC. The EMCA annual ESCO survey data has shown that growth rates of these indicators becomes smaller year after year, even though their absolute values grow much larger each year—indicating that when the base becomes larger, growth rate becomes increasingly smaller. As a result, an estimate would not be accurate if the growth rate of previous periods was simply used to extrapolate the future market size. Therefore, we used four alternative scenarios to estimate the future growth rates under different assumptions of the future ESCO market. The low-to-moderate growth assumes that the market is relatively mature and growth would slow to the current growth level of the U.S. market. The moderate-to-high growth is estimated based on historical growth rates since 2005, taking into consideration China's future possible economic growth. The extremely high growth assumes that the ESCO market would maintain its high growth rate seen in the past three years and this is accompanied by significant growth in capital markets and technical capacity. However, it is worth nothing that we did not quantify the low growth scenario, in which the ESCO market might be constrained by the availability of capital for financing, the growth rate would be flat or declining, and the market size by 2020 is similar to today's market size, for example.

Several factors (e.g., demand for energy savings, market liquidity, technical capacity, etc.) affect the growth of the ESCO industry and EPC market. Depending on how these factors interact with each other, the market growth rate can vary greatly. We conducted preliminary analysis on the future market growth, and the results show great uncertainty. The projected EPC investments[5] by 2020, adjusted for inflation, range from $17 billion to $67 billion (based on 2005 constant price),[6] based on assumptions of various growth rates from 8.3% to 31.7%. However, these numbers only reflect moderate to high growth of EPC investment based on the business-as-usual case. As discussed above, limitations in accessing capital markets may constrain the development of EPC projects, which, if it happens, would significantly slow down the growth in the ESCO market and the EPC investments in 2020 may be close to what it is today (about$12 billion).

We also estimated the potential share of ESCOs in China's total energy-saving market,[7] based on expected energy savings during the 13th FYP period and the forecasted savings that can be achieved by China's ESCO industry. We estimate China's total energy savings potential using this formula: annual energy saving = (energy consumption per GDP in current year - energy consumption per GDP in previous year) * GDP in current year. As seen in Table 7, ESCO share of the total savings could increase from the current actual ESCO share of China's total savings of 18% to an average of 33% and 37%, respectively, under the two scenarios for the period leading to 2020.

Table 7. Actual and Forcast of China's ESCO Industry Market Share

Actual Share		**Estimated Share**	
Actual share in 11th FYP (2006-2010)	**Actual share in 2013**	**Scenario**	**Estimated share in 13th FYP (2016-2020)**
5%	**18%**	**Modest changes**	**33%**
		Accelerated changes	**37%**

Note: Assumptions under the modest changes case include GDP growing 7% annually in 2014-15 and 6% annually in 2016-2020 and energy intensity (i.e., energy consumption per unit of GDP) improving 14% in 12th FYP and 10% in 13th FYP. Assumptions under the accelerated changes case include GDP growing 7% annually through 2020 and energy intensity improving 16% in 12th FYP and further improving 16% in 13th FYP.

[5] EPC investment is the total amount of invested capital which includes both the equity invested by ESCOs and the finance ESCOs obtained
[6] We adjusted the historical data on EPC investments (i.e., 2005-2013) for inflation by using the price indices for fixed assets investments. The projections of the future market were based on the adjusted EPC investments. The price indices data were obtained from the Chinese Statistical Yearbook.
[7] Total energy savings include savings achieved from both ESCOs and non-ESCOs.

The ESCO industry in China has great growth potential due to a variety of factors. For example, removing the ESCO registration requirement may open up new regional markets which were confined to local firms. China's rapid urbanization coupled with growing interest in improving the performance of existing buildings presents a significant opportunity for retrofits. NDRC and the State Bank Supervision Commission issued the *Energy Efficiency Financing Guide*, which encourages financial institutions to provide a greater range of financing options for EPCs. Moreover, increases in energy prices, adoption of a total energy consumption cap, and establishment of an emissions price will likely stimulate deep energy savings. Central government policies to promote performance-based contracting in public facilities are opening significant new options for EPCs. At the subnational level, provinces and cities are adopting innovative measures to address traditional challenges. The Shenzhen government issued a directive making EPC a leading means to retrofit public facilities. The city reformed its budget allocation practices by allowing public entities to keep their energy budget to make EPC payments, rather than reducing the budget in accordance with lower level of energy demand.

More players have entered China's EPC market. Over the past two years, an increasing number of state-owned companies have established subsidiaries, including State Grid, Southern Grid, Shanghai Bao Steel, Sinochem, Sinopec, CNOOC, Shenhua, China Power Investment, and Datang (EMCA 2014). Also, foreign-invested companies and multinational corporations entered China's energy services market. For example, Carrier Asia and Shanghai Electric jointly established a specialized energy services company, and Philips established two subsidiary ESCOs - Shanghai Liyi Energy-Saving Technology Services Co., Ltd and Philips Energy-Saving Technology Services (Wuhan) Co., Ltd. (EMCA 2014). The entrance of large companies equipped with sophisticated technologies and experience will further increase competition and innovation.

Many linked factors hamper further growth of the market, including the difficulty of assessing the credit worthiness of hosts, limited use of transparent M&V, the variability of performance-based payments under shared savings, limited access to diversified financing, and the small average ESCO size and the requirements that the ESCO provide project financing in the shared savings model. Clearly thought-through policy can help mitigate these challenges.

Current Market in the United States

The U.S. ESCO Industry

The U.S. ESCO industry began to tap the market for energy efficiency retrofits in the 1980s. The industry has undergone many transformations since its launch. Like in many countries, ESCOs' initial business model was fee-for-service subcontracting, which later evolved into contracts paid for from shared savings, mostly in the industrial sector. Contracts were typically small, as were the ESCOs. At this early stage, utility energy efficiency programs helped sustain the market. The market grew substantially when the federal government authorized EPCs in federal facilities in 1992 and issued requirements that drove demand for energy efficiency products and services (EPAct 1992). Initially the federal government also relied on shared savings contracts where the ESCOs took on financing risks. However, in the mid-1990s, both the government and the industry as a whole shifted to guaranteed savings contracts to reduce transaction costs and open new financing options, according to ESCOs and Federal Energy Management Program (FEMP) officials (Gilligan 2011). This led to further growth in the sector. In the 2000s, the industry consolidated through mergers and acquisitions, and by 2008, 12 companies, each with revenue of over $100 million, accounted for 88 percent of the industry activity (Satchwell, Larsen, and Goldman 2011).

This section will outline the structure of the U.S. ESCO market today and key elements behind the growth of this market in recent decades.

The U.S. ESCO Market Today

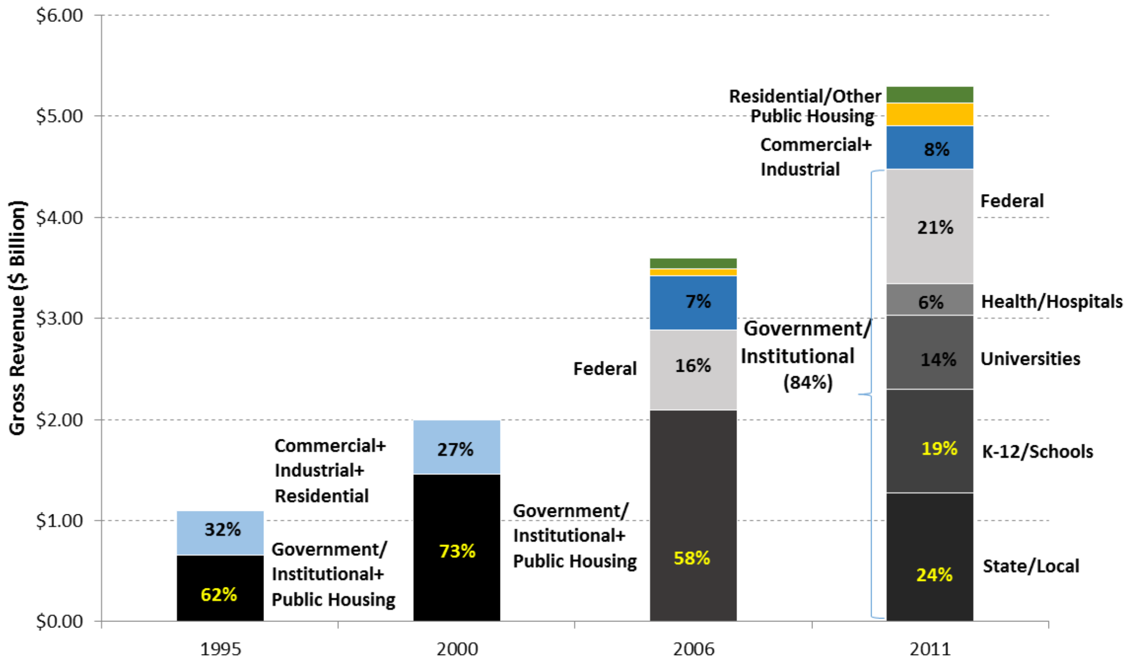
Today, ESCOs in the United States report aggregate revenue of approximately $5 to 6 billion per year (Stuart et al. 2013) and operate in a dynamic and evolving landscape in the United States where new business models and financing solutions are being developed and deployed to address long-standing barriers specific to certain market segments that are well known to the industry. Previous studies estimated that ESCOs' annual revenue was $3.6 billion in 2006 and $2 billion in 2000 (Hopper et al. 2007). In other words, between 1996 and 2011, the industry revenue grew about 7–9% annually[8] (Larsen, Goldman, and Satchwell 2012; Osborn et al. 2002; Stuart et al. 2013).

EPCs dominate the ESCO business, accounting for about 70% of revenue (Stuart et al. 2013). This has not changed from the previous decade; studies reported the share of EPCs to be 69% and 70% in 2008 and 2006, respectively (Hopper et al. 2007; Satchwell et al. 2010).

Government and institutional facilities[9] host the majority of EPCs in the United States, representing between 73 and 84 percent of the tracked project volume since 2000 (see Figure 5) (Larsen, Goldman and Satchwell 2012; Osborn et al. 2002). The share of revenue from the government and institutional sectors has significantly increased since 1995. The success of the EPC market in this segment can be largely attributed to legislative support and programs such as FEMP, as well as new contracting and financing approaches that allowed the market to grow. However, it is important to note that public sector and large, not-for profit organizations (such as hospitals and universities) publicly report projects more often than do private commercial and industrial companies (Osborn et al. 2002). In addition, reports do not distinguish between public and private universities, hospitals, and schools, which makes the commercial building category seem smaller than it would otherwise.[10]

Figure 5. Share of ESCO Revenue by Market Segment Between 2000 and 2011

[8] Industry revenue data are not available for the years 2001-2003.
[9] In the United States, ESCOs and others typically use the term municipal, universities, schools, and hospitals (MUSH) to cover those sectors, but because international readers may not be familiar with this term, we are using the broader phrase "government and institutional," which covers MUSH but also includes state and federal facilities.
[10] From a procurement perspective in China, there are significant differences in the requirements in public buildings versus private or commercial ones. Many states within the United States have adapted their procurement rules to accommodate EPCs.



Sources*:* Goldman et al. 2000; Larsen, Goldman and Satchwell 2012; Osborn et al. 2002; Stuart et al. 2013.

Notwithstanding the data issues mentioned above, U.S. ESCOs have not, in fact, been as active historically in the commercial, industrial, and residential sectors as they have in the public and institutional markets—though innovative projects, particularly in the commercial and residential market segments, are changing this. ESCOs do work with large commercial organizations that both own and manage their space (such as hospitals, schools, and universities). It has been historically harder for them to work in leased commercial space, where the owners and occupants may have split incentives—but innovative financing mechanisms are beginning to be deployed to overcome this barrier. Still, there is much potential to expand in the commercial building market: Johnson Controls' Empire State Building retrofit is a prime example of this.[11] The project achieved an estimated 38% savings compared to pre-project consumption (the savings significantly exceeded the guarantee of 20% savings, a major plus for the customer). Multi-party participation helped overcome the split incentive problem, and helped ensure that both the owner and the tenants worked together to achieve deep savings. Industrial companies often manage their own energy efficiency investments, and comprehensive industrial retrofits usually require significant process-related expertise, in addition to expertise on energy operations. Industrial activity can be also hard to predict because energy use is closely linked to products and output, which can vary with demand; this makes EPC projects riskier. Thus, the industrial market has not grown as rapidly as the buildings market in adopting guaranteed savings EPCs. The residential market has historically been difficult to tap because of the multitude of small buildings and owners, though recent innovations in financing mechanism are helping to overcome long-standing barriers and scale consumer homeowner credits. Significant advances have been made recently in terms of the securitization market for energy efficiency loans for customers in the residential sector (e.g., the Warehouse for Energy Efficiency Loans, or WHEEL), however, these are not currently structured as EPCs (NASEO 2014). Health facilities, hospitals, and K–12 schools may represent important areas for future growth based on recent trends (Stuart et al. 2013).

[11] For more information about this example, visit: http://www.esbnyc.com/documents/sustainability/ESBOverviewDeck.pdf.

Elements Behind the Growth in the U.S. ESCO Market

The U.S. ESCO market has grown from $500 million in 1985 to $6 billion in 2010 (Chan 2012; Stuart et al. 2013). Energy Efficiency Portfolio Standards and laws on public disclosure of energy and water consumption in buildings have increased awareness, but several other key elements have helped spur the growth of this sector:

- Move to guaranteed savings and third-party financing
- Model contracts and Super EPCs[12]
- Standardized M&V protocols
- Public sector and institutional requirements for greater efficiency
- Tools and support for EPCs

These elements work together to create synergies that in turn spur growth. For example, many of these elements make it possible for clients to access lower cost financing, which supports potentially longer contract terms and the number of cost-effective retrofit opportunities—which in turn means comprehensive retrofit projects. Table 8 shows the importance of each of these innovations.

Table 8. Innovations Spurring the Growth of the U.S. ESCO Industry

Innovation	In a Nutshell	Importance
Guaranteed savings	EPC contract where the ESCO guarantees a certain level of savings, and savings above that go to the client. Typically also includes a shift to third-party financing for the host building customer.	Lowered transaction costs for M&V disputes. Clear payment schedule made budgeting and financing easier.
Third-party financing	New, outside financing sources. Project costs no longer on ESCO's balance sheet, but rather on that of the customer or a third-party special-purpose fund.	Lower interest rates and longer terms. Allowed ESCOs to take on more projects (no longer constrained by available working capital).
Model contracts and SuperEPCs	Federal government and several states negotiate Super EPCs with standard language. Sample model contracts publicly available, incorporating M&V in savings calculations.	Reduce bureaucracy of signing EPCs, lower transaction and interest costs (because of volume and standardization), increase access to financing.
M&V Protocols	Standardized, robust, and consensus-based protocols for M&V.	Clear documentation of results, which helps customers make the business case. Increased access to financing, lower interest rates, link to model contracts.
Public/institutional efficiency requirements	Governments and some institutions now require their facilities to meet increasingly	Increases the demand for energy efficiency services and the willingness of government to

[12] The federal government and many states call these Super Energy Service Performance Contracts or Super ESPCs. For consistency in terminology, this report uses the broader term, EPC. EPC includes ESPCs, which involve guaranteed savings contracts, but also other related contract types—such as performance guarantees—which are a type of performance-based purchasing agreement.

	stringent energy savings targets.	design Super EPCs. M&V helps track results, allowing for tightening of requirements over time.
Tools and support	Software calculators, databases, assistance from industry associations, training, and technical assistance.	Lower transaction costs, increase capacity to do EPCs, facilitate knowledge transfer and speed of innovation.

Move to Guaranteed Savings and Third-Party Financing

Contract and financing structure have played a key role in the growth of EPCs in the United States, as EPC parties have experimented with different options to alleviate bottlenecks associated with financing availability, transaction and interest costs, and financial risk. The largest growth in the market occurred after 1995 with the advent of guaranteed-savings contracts and third-party financing (Chan 2012, Nesler 2013). To explain the importance of this change, it might be helpful to first outline how its predecessor, the shared savings contract, worked. Shared savings contracts were the first financial model in the United States allowing customers to pay for the initial energy efficiency retrofits from the savings those retrofits generated. This in itself was a major innovation because it assured customers that their energy efficiency investments would not cost them money out of pocket. However, shared savings contracts have several drawbacks (Gilligan 2011). Shared savings contracts have variable payments based on the actual savings, not fixed payment schedules. This makes it harder for customers and ESCOs to budget, and makes it more difficult to finance the deals because the payments cannot be easily matched to a loan schedule. Finally, when ESCOs take out loans or leases for EPC investments under shared savings, their credit capacity caps the total number of projects they can maintain in their portfolio. This fact leads ESCOs to sign contracts with shorter-terms and less comprehensive retrofits. The financing risks also meant higher relative interest rates, which further reduced the number of measures possible.

In the late 1980s, ESCOs began to propose a new financing and contractual model, guaranteed savings, which was driven in part by state and local governments, schools, and hospitals that could use tax-exempt leases and bonds. Large customers, such as FEMP, were also seeking deeper retrofits with lower financing costs and simpler start-ups. Under guaranteed savings contracts, the ESCOs guarantee a certain level of savings, and savings above that level accrue to the customer. The guarantee ensures that the customer's total energy and energy savings bill will be sufficient to cover the debt service payments on the EPC project over the contract term (with some adjustments according to baseline conditions). Because of this guarantee, it is easy to schedule fixed payments over the project term. A third party will then finance the project going forward. For example, state and local facilities often rely on bonds because they can get better interest rates. The federal government relies on forfeiting, or selling the future receivables to a specialized financing company (in which the government customer can treat the EPC payments as an operating expense). Several banks have developed special credit structures dedicated to EPC financing (ICFI and NAESCO 2007).

Other important types of financing include government lease purchases, bonds, grants, utility incentives, and other direct allocations, such as capital funds. In 2010-2012, the role of state and municipal loan programs increased sharply because the federal government had allocated over $11 billion to finance energy efficiency programs at the state and local level, as part of the American Recovery and Reinvestment Act (Kats et al. 2011).

To back up their savings guarantee, ESCOs may also buy performance bonds as security, in that the contract will be performed and completed in accordance with its terms and conditions. In federal projects, these bonds are for a year, but the ESCOs involved are all large, with established credit ratings. In some state and municipal projects, the bonds may last for the duration of the project. In addition, some ESCOs purchase energy performance insurance as a credit enhancement to their technical performance guarantees, which is particularly beneficial for tapping smaller projects and new markets, integrating new technologies in retrofits and reducing the amount of contingent liability arising out of performance guarantees that would be required to be reflected on balance sheets and would, in turn, be publicly disclosed, as applicable.

Construction financing may be somewhat distinct from the financing for the implementation phase of the project. The same financing source may apply to both phases, but ESCOs will usually have a greater share of financial risk during the construction phase. Table 9 describes some of the financing options available. Little data exist on the share of these financing types in the U.S. EPC market, but the table sets forth commonly used financing mechanisms.

Table 9. Types of EPC Financing in the United States

Types	Funding Sources	Notes/Examples
Most Common Types of Financing		
3rd party loan	Commercial banks or specialized funds	Host customer takes out a loan or a lease from a bank or specialized fund (under shared savings, the ESCO would take out the financing). Examples of financiers include Bank of America, Bostonia Group, PNC Bank and Citigroup.
Factoring (forfeiting)	Commercial banks	A third-party financial institution buys the future receivables from the EPC at a discount, paying the ESCO as soon as the project is completed. This is one way to convert the capital cost of the EPC into an operating expense so that it does not appear as an obligation on the customer's balance sheet. The federal government uses this approach.
Government bonds	State/local government client	States or local governments bundle projects and sell bonds with approval of the legislative body and/or voters. $1.5 million of Qualified Energy Conservation Bonds financed EPCs in Boulder Colorado.
Additional Types of Financing		
Lease financing	Client budget	A contract, where lease payments can coincide with energy saving payments. This can include capital leases, operating leases, or, where available, tax-exempt lease purchase agreements.
Special purpose vehicles	Bonds or loans, typically	Can exist in several forms. Specialized quasi-state or local agencies may issue bonds for government projects (e.g., trusts and funds in Maryland and Chicago). May be off balance sheet for the government. Private special purpose vehicles also exist,

		and may use loans or factoring.
Customer capital funds	Client budget	Particularly popular in commercial and industrial institutions.
Incentives, grants, and low-interest loans	Utilities, and federal, state or local governments	Utilities will often provide incentives for EPCs from bill charges that help meet state energy efficiency portfolio standards. Some states also allow utilities to finance energy efficiency projects through on-bill financing, or will provide low-interest loans, though in most cases, such financing is not EPC-based. Where possible, ESCOs tap existing government tax benefits and other incentives.
Emerging Types of Financing		
Property Assessed Clean Energy (PACE)	Federal grants, municipal bonds and possibly private loans	A loan secured property value to fund energy improvements on low-density residential units. Property owner repays through a charge on the real estate tax bill. However, this mechanism is facing regulatory hurdles in the residential sector in view of lien priority determinations. California, New York, and Connecticut are working on such programs in the commercial sector.
Sustainable Energy Utility (SEU)	State-issued revenue bonds	State issues tax-exempt revenue bonds that offer lower borrowing costs than commercial bonds. Participants sign four interrelated contracts: (a) a guaranteed savings agreement; (b) an installment payment agreement; (c) a program agreement; and (d) an indenture. Revenue bonds have been developed in Delaware, California, and the District of Columbia.
Energy Services Agreements (ESAs) and Managed Services Agreements (MESAs)	Debt and equity investment in a special purpose vehicle (SPV) which owns the energy efficiency project	A project developer or other third party arranges for ESCO's installation of energy efficiency measures and coordinates the capital investment in the project. Project developer typically owns (through an SPV), operates and maintains the project, while the host customer pays for energy saved (aka "negawatts") as a service based on percentage of actual energy savings achieved or fixed dollar amount per kwh saved. ESCO provides a performance guarantee to the host customer or project developer. The Chicago Infrastructure Trust has used a similar off-balance sheet model through a non-profit trust entity which is the obligor of the loan to deploy energy efficiency upgrades to the city's public buildings.

Other efforts to create a secondary market for energy efficiency financing	Various	Several private banks, states, utilities, and other institutions are working to create vehicles to sell large pools of like credits to capital markets to increase capital availability, reduce financing and transaction costs and address specific market barriers, such as extending loan terms to allow for deeper retrofits. These efforts have focused primarily on public and residential markets, but there are also efforts to work with commercial facilities, for example, through PACE or the Green Campus initiative.

Sources: Kats et al. 2011; Energy Service Coalition 2014; ICFI and NAESCO 2007; FREE 2013; Wilson Sonsini 2012.

This table highlights major types of financing for EPC. It is worth noting that there are additional types of EPC contracts and other types of financing for energy efficiency that may not link directly to EPCs. This paper will not cover these in depth, but two examples that highlight these trends include energy service agreements and emerging efforts to pool or warehouse finance (such as WHEEL and new state-level energy efficiency funds).

Energy service agreements allow customers to obtain energy efficiency services with minimal capital investment. Project developers obtain financing for the project, and then own, operate, and maintain it, while the customer pays operating costs set as a an additional fee on top of their reduced energy bill—or as a single payment to the project developer that encompasses both the energy costs and the repayment of the retrofit. Project developers typically structure such agreements through special purpose vehicles, which may allow the customer to treat the deals as off-balance sheet operating costs. Often, such projects emphasize efficient supply of heating, air conditioning, and other energy-related services.

Several states and private companies are working to developing a secondary market for energy efficiency debt. Some examples include WHEEL, which pools unsecured residential energy efficiency loans with state incentives to buy-down costs, and converts them to private bonds that provide project access to capital markets at low cost. New York has also recently set up a Green Bank that will facilitate private sector financing in clean energy markets by warehousing projects from private lenders and/or by working to extend project terms and reduce interest rates. Connecticut also has a similar effort through its Clean Energy Finance and Investment Authority. All of these efforts seek to use public and/or utility financing to leverage capital markets. For example, the Connecticut Clean Energy Finance and Investment Authority achieved nearly as much clean energy investment in its first year of operation as its predecessor had through incentives in the previous 10 years of operation (NASEO 2014; NY Green Bank 2014; Clean Energy Finance and Investment Authority 2014).[13]

Model Contracts and SuperEPCs

Model contracts in the ESCO industry have built customer trust, lowered transaction costs, and increased the availability of financing. A good contract between the ESCO and the recipient of the services can reassure both parties that the EPC project will be viable by

[13] The authors also drew from interviews with, and the generous insights of, several key industry leaders, including Bruce Schlein (Citibank), Alfred Griffin (NY Green Bank), and Bryan Garcia (Clean Energy Finance and Investment Authority).

setting forth all the necessary ground rules for the project. It would be unreasonable to expect that every potential recipient of services would have the background and knowledge to write their own contract, but every potential recipient can review a model contract to see what portions of that contract may be directly applicable to their project. There are many details associated with an EPC contract including issues such as what happens if the building involved in the EPC is abandoned by the recipient of the energy services; what happens if the savings predicted by the EPC do not occur; or what happens if the occupants of a building involved in the EPC change their work schedule. These issues, and many others, can be dealt with in a model contract. They describe the link between the contract and M&V protocols.

The success of EPCs in federal and state/local facilities over the past decade is partly due to flexible contract structures. At the federal level, U.S. Department of Energy (DOE) established FEMP to support contracting with federal facilities. Several states and localities have made major pushes to improve energy efficiency in public facilities, setting up umbrella contracts that public facilities in their jurisdiction can easily tap, and placing energy savings requirements on facilities. States may also offer bonds to finance EPCs or set up other specialized financing facilities. Also, DOE’s Weatherization and Intergovernmental Program and other initiatives, through the Energy Services Coalition (ESC) and the National Association of Energy Services Companies (NAESCO), offer resources, grants, and technical assistance to assist with procurement and implementation of EPCs (DOE 2014b; ESC 2014).

One of FEMP’s biggest achievements is consistent support and responsiveness to industry feedback on contracting with federal facilities. When the industry noted that the contracting process was slow and expensive, FEMP introduced a contract structure that allowed companies to compete for large “umbrella” contracts every five years (SuperEPCs). Companies can win contracts back-to-back, and poor performance will reduce the chance that they win a new contract. There are several criteria for selection, and the specific criteria may change over time, but generally speaking, companies must be financially stable, show strong past performance, and provide competitive contract terms, including profit margin. Individual agencies can pick among 15-20 ESCOs with SuperEPC contracts in place and award individual task orders, which can last up to 25 years. This approach significantly cuts down on procurement expenses, while adding flexibility that enables ESCOs to conduct more in-depth audits and analysis before guaranteeing savings. As a result, projects in this sector tend to be large, multi-measure retrofits they deliver deep energy savings; large ESCOs are in the best position to implement and attract financing for such projects. Most EPCs in federal facilities are worth between $2 million and $20 million, generating savings in approximately the same amount (DOE 2013). The government finances the projects as operating expenses through companies that purchase the receivables (forfaiting). Several states have similar programs. For example, Maryland issues SuperEPCs to 8-10 ESCOs every 3 years. State agencies and counties can use these contracts to sign 15-year task orders for large, multi-building projects. The state finances most of these projects through state or quasi-state bonds.

M&V Protocols

A standardized approach for M&V is especially important for deep energy savings retrofits involving multiple technologies requiring detailed methods for M&V calculations. It has led to clearer responsibilities for both ESCOs and customers, which has increased satisfaction and acceptance of EPCs and led to more trust in the EPC market. Standardization has also been critical in making financing available and lowering financing costs. This standardization has been particularly successful because industry, energy efficiency customers, and researchers worked together to develop the rules so there is buy-in from all parties (Kats et al. 2011). For M&V, ESCOs use the IPMVP (EVO 2012), which is codified as ASHRAE

Guideline 14-2002 *Measurement of Energy and Demand Savings* (ASHRAE 2002) and the FEMP M&V Guidelines (DOE 2010). Quoting from the IPMVP website, "The IPMVP provides an overview of current best practice techniques available for verifying results of energy efficiency, water efficiency, and renewable energy projects in commercial and industrial facilities." Quoting from the foreword to ASHRAE Guideline 14-2002, "Use of ASHRAE Guideline 14 is expected to provide savings results sufficiently well specified and reasonably accurate so that the parties to the transaction can have adequate assurance for the payment basis." The M&V protocols cover issues such as data gathering and screening; meter calibration and maintenance; acceptable methods for calculating baselines and savings estimates; variables that affect post-installation performance (such as weather and building load) reporting; quality assurance; and third-party verification of reports. The existence and use of independent M&V protocols provides the recipient of the services the assurances they need to enter into an EPC contract and provides the ESCO with direction on the minimum requirements necessary to verify their savings. Financing costs for any projects, including EPC projects, depend on the level of risk associated with the project and anything that can reduce the risk of the project will result in lowered financing costs. Knowing that the savings projected in the EPC project will actually be achieved is an important part of reducing the risk of EPC projects. Use of the IPMVP or other standardized guidelines is an important part of achieving those savings.

Public and Institutional Efficiency Requirements

Many organizations in the United States have set specific targets and requirements for energy savings in their facilities. This has driven the growth in EPCs in the public and institutional sector. Table 10 provides examples of such requirements in different levels of government and institutions.

Table 10. Examples of Public Energy Efficiency Targets and Requirements

Entity	Target	Other Requirements
Federal Government	30% reduction in energy use per square foot by 2015 compared to 2003	Each agency must designate a Senior Sustainability Manager; prepare annual scorecard that agency head presents to President
State of California	20 percent energy savings between 2003 and 2015	Large new buildings must be LEED Silver; new buildings after 2025 must be net-zero energy[14]
New York City	Reduce greenhouse gas emissions from City operations by 30 percent by 2017 compared to 2006	Most new city government buildings must be LEED certified
Georgetown University	Reduce greenhouse gas emissions by 50 percent per square foot by 2020 compared to 2005	All new construction LEED Silver or higher; increase in purchases of renewable energy and other targeted investments

Sources: DOE 2014a; State of California 2012; PlaNYC 2014; North Carolina Solar Center 2014; Georgetown University 2014.

[14] Roughly speaking, net-zero energy buildings are very efficient buildings that produce or purchase renewable energy to cover their remaining demand.

Tools and Support

Federal and state governments provide many types of support for EPCs, including training and technical assistance. FEMP has numerous webinars and in-person trainings available on different aspects of EPCs for federal managers. It also provides technical assistance to agencies and arranges more in-depth assistance with contract facilitation for a fee. Several states also provide similar assistance to agencies in their jurisdiction.

Several organizations also support or represent the ESCO industry. NAESCO is a national trade organization made up of ESCOs and industry experts. It promotes energy efficiency and EPCs in the market, to government at various levels, and to the media. The Energy Service Coalition is a public-private partnership that raises understanding and capacity for EPCs. It offers model contracting documents for state and local officials as well as other useful resources. Appendix F provides additional information on these and other organizations and initiatives.

The technical assistance, institutions, and tools available to U.S. ESCOs and their customers have helped expand the market by building capacity, simplifying certain processes, and creating platforms to replicate market innovations. The tools help make investment decisions easier, implementation smoother, and calculation of savings more accurate.

The existing tools range from specialized investment planning tools like the Facility Energy Decision System (FEDS),[15] that allows facility managers to quickly identify possible measures for EPC and investment consideration, to more general building energy simulation tools or savings estimators. They also include extensive information on M&V, tools to adjust energy pricing in contracts based on real changes in energy prices, and project databases. Appendix G has more information on these tools. DOE also maintains a directory of existing programs and applications that support energy efficiency investments: http://apps1.eere.energy.gov/buildings/tools_directory/subjects_sub.cfm. This directory includes tools developed in the United States and internationally for various sectors and facility types. Finally, LBNL and NAESCO maintain an online ESCO project database, *eProject Builder* (https://eprojectbuilder.lbl.gov/), that allows collecting and tracking project-level information, creating basic contract and reporting documents, and performing analysis of achieved and proposed savings.

Major Barriers

The majority of EPC projects implemented in the United States occur in government and institutional facilities, and EPCs have a low penetration level in other commercial properties and industrial facilities. This is because, compared to the commercial and industrial sectors, government and institutional facilities tend to have strong targets for energy efficiency, they have capital constraints that make EPCs attractive, and, in some cases, they have developed relatively easy procurement systems with SuperEPCs. ESCOs are also familiar with these markets, so it is easier for them to identify new projects. Compared with private sector hosts, government and institutional facilities in the United States have fewer costs for credit assessments because they tend to be investment-grade, creditworthy institutions with extensive credit rating data. As a result, this also lowers the risk that ESCOs or third-party financiers assume in the government and institutional market.

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[15] Public sector managers have widely used FEDS. Private building managers also rely on it. It is often a first step in defining the scope of a possible EPC.

There are several barriers preventing greater penetration of the EPC model in commercial buildings and industrial facilities (Kapur et al. 2011):

- Commercial and industrial facilities in general have weaker incentives and targets for energy efficiency improvements than those in the public or institutional sector in the United States. As a result, commercial and industrial facilities have historically tended to limit retrofits to very short payback measures that reduce the size of potential EPCs, though this pattern may change in view of recent financing innovations.
- Commercial and industrial projects may have high development costs, as identification and aggregation of energy efficiency projects, in part because ESCOs are not as familiar with these markets and in part because of facility size.
- Commercial and industrial clients may be particularly concerned about data sensitivity and site security.
- Lease arrangements in office buildings and some other commercial spaces create a split incentive that makes it difficult to arrange EPCs.
- In industry, ESCOs may need specialized industrial process experience to help win clients over to deep retrofits. Large companies with strong energy efficiency targets may already have in-house teams specialized at efficiency improvements, particularly if the company has established deep energy efficiency targets.
- The financial market has comparatively few products designed to serve energy efficiency improvements in large commercial customers and industrial end-users. However, this is changing with the innovation of energy services agreements and managed energy services agreements, which are designed to overcome split incentive barriers.

Residential markets have also historically faced many barriers because of small project size and the unavailability or fragmented nature of data on consumer credit histories. Several states have attempted to change this with scaling programs such as Property Assessed Clean Energy (PACE), but change has been slow because of regulatory concerns in the mortgage markets. The residential markets, however, gained traction this year with several new initiatives—Kilowatt Financial and WHEEL (though they are not strictly speaking EPCs).[16] Although the government and institutional sector market has a higher penetration rate, policy barriers often prevent further expansion of the EPC model in the government and institutional market. Public institutions in many states face a paradox; government policies fail to incentivize investments, as energy savings may lead to a reduction in the next year's budget. ESCO's capacity to facilitate comprehensive retrofits in the government and institutional market may be restricted by state laws that determine how a public entity can acquire a project or by policies on how to upgrade and maintain public buildings. In addition, government and institutional facilities have limited capacity and staff resources to identify and pursue energy efficiency opportunities. In other words, EPCs tend to be concentrated in the federal government and in states that have made policy changes to facilitate EPCs. At the same time, ESCOs and their customers may not always have the capacity and desire to take on the deepest retrofits with the most innovative technologies, which have greater risk and longer payback periods. An additional barrier is that ESCOs tend to favor states where they already have a presence because of cost and familiarity with the market. Thus, most EPCs are concentrated in a few, large states such as New York and Pennsylvania.

Finally, there are some common barriers to implementing the EPC model in all sectors in the United States, including high upfront capital costs, uncertainty of savings and perceptions of

[16] These transactions facilitate the development of a secondary securitization market providing low-cost capital for consumer energy efficiency home loans that should enable scale up of investments in this sector.

risk, lack of secondary markets for re-financing, and long contract negotiation periods. The industry has worked hard to address many of these issues through the EPC contract and financing structure, but deep retrofits by nature remain costly.

Future Markets

As we noted earlier, the ESCO industry in the United States has been growing at a steady pace in the past few years. The reported revenues for 2011 are approximately $5.3 billion. The estimated revenues for 2013 and 2014 are approximately $6.4 billion and $7.5 billion, respectively. Data for industrial facilities and private commercial properties is difficult to obtain, and revenues from such projects might be higher. Market penetration of performance contracting is highest in the K-12 schools sector and lowest in the commercial buildings, industrial, and healthcare sectors (Stuart et al. 2013).

There are still vast opportunities in the U.S. ESCO market. The preliminary analysis found that the remaining investment potential for federal, public, institutional, and private commercial buildings ranges from $71 to $133 billion,[17] and private commercial buildings, hospitals, and K–12 schools have the largest estimated remaining market. Although the remaining market potential is lower in the federal, state/local, and university market segments, ESCOs have a high likelihood of capturing this potential because of a proven track record of working in these markets. In terms of energy savings, private commercial buildings have the highest potential. The investment and energy savings potential for the residential sector is significant; new financing mechanisms for the residential sector such as WHEEL and Kilowatt Financial may extend to residential energy efficiency projects in the future, once this secondary financing market is better established. Most existing reports in the United States do not study the market potential of the industrial sector, given the limitation in data availability. The industrial sector is likely to have large EPC investment potential because of the current low level of market penetration, opportunities in energy savings and relatively large project size (Fulton et al. 2012; Stuart et al. 2013).

The ESCO industry in the United States is projected to more than double in size by 2020, growing to $11-$15 billion[18] (Stuart et al. 2013). Many factors may positively influence the future growth of the U.S. ESCO industry in the long term and help capture the remaining market potential. Federal, state, and local legislations and programs that allow long-term performance-based contracting in institutional markets will continue to be an important driver of the U.S. ESCO market. For example, cities with building energy benchmarking and energy-use disclosure policies may help spur energy efficiency retrofits in commercial and institutional buildings. Potential increases in energy prices (or putting prices on emissions) may also stimulate demand for deep retrofits. New business models such as on-bill financing may eventually remove barriers and increase penetration of performance-based services into underserved markets such as the private sector. Moreover, if major barriers for commercial buildings and industrial facilities are removed, this will significantly increase the scale of the ESCO market and the level of energy savings. Opening up new markets may further increase the market growth. In Canada, schools are beginning to include new construction in performance contracts. If the U.S. market for new facilities opens up to ESCOs, it could be an important driver for new business growth. At the same time, several factors could also lead to

[17] These estimates are based on the current building floorspace and market penetration level.
[18] It is likely that the market will grow more slowly than projected, as previous projections for some years were higher than reported revenues. But it is also worth noting that this number may underestimate EPCs in industrial and commercial sectors because of limitations in data.

slower or flat growth in the U.S. market—including traditional fluctuations in economic cycle, reductions in government support and/or additional regulation of ESCOs (Stuart et al. 2013).

Comparison and Integrated Review of the United States and China EPC Markets

China's ESCO industry is growing fast and its EPCs have primarily concentrated on improving energy use in industrial operations. Chinese ESCOs are particularly adept at smaller and common projects that allow for widespread implementation, rather than comprehensive projects that integrate a range of technologies to achieve optimal results and capture deep energy savings. The country has significant room to expand EPCs in terms of carrying out deeper energy savings retrofits and developing market share in new industrial applications and new sectors, such as public, commercial, and possibly residential buildings. By contrast, the U.S. ESCO industry has been very active in government and institutional markets; it has developed to support multi-technology retrofits with deeper energy savings. The U.S. ESCO industry still has more room to grow in terms of fully tapping the industrial, residential, and commercial buildings market segments, and expanding the EPC market in more states. This section will explore several themes related to the complementary strengths and needs of the EPC market in each country—in particular market drivers, technologies, contract type, financing, and M&V rules. To begin, we provide a quick snapshot comparing the two EPC markets (see Table 11).

Table 11. Comparing the EPC Markets of China and the United States

Indicator	China	United States
EPC investments 2011[19]	$6.38 billion	$6.32 billion
EPC investments 2013	$11.98 billion	$7.62 billion
Dominant market segment (% share) in 2013	Industry (72%)	Government and institutional (84%)
Typical project size	$100,000-$1 million (2007-09)	$2 million-$15 million
Number of measures involved in EPC project, typically	Selected and specialized, less integrated	Multiple and integrated
Typical contract term	4-8 years	10-20 years
Thrust of government support for EPCs	Energy saving targets at national, sub-national, sector and enterprise level; tax exemptions and financial rewards targeting shared savings projects; technical assistance via training and best practices	Energy saving targets and procurement rules for public sector projects; extensive technical assistance via tools, best practices, and trainings; utility energy efficiency portfolio standards at state level
Dominant contract type for EPCs	Shared savings	Guaranteed savings
Typical financing	ESCO provides financing from	Customer finances with loan,

[19] For the United States, the 2011 figure is based on reported numbers, and the 2013 is based on estimated data. For China, EPC investments for both years are reported data. ESPC project costs normally include project investment, performance-period services, M&V services and financing-related costs. The U.S. EPC investments include ESCO revenue and adjustments to include financing-related costs. We use the share of financing-related costs reported in FEMP, based on 31 projects awarded after competition in financing was required. We use the average nominal exchange rate for a particular year from the China Statistical Yearbook.

arrangements	its own capital and, increasingly, by taking out a loan. Some ESCOs are exploring more innovative financing arrangements such as leasing	lease, bond, or (in some cases) financing structured as operating expenses. Many different financing mechanisms for different contract structures
Standardized contracts and M&V protocols	National standards on contracting and M&V with a focus on shared savings contracting model. Lack of a comprehensive M&V protocol that covers integration of multiple measures	Standardized, stakeholder-developed contract models and detailed M&V guidance. M&V includes several detailed, mutually compatible protocols in wide use, supporting a range of contract types

Market Drivers

Growth in both countries is linked to both supportive policies and market conditions. In China, government energy-saving mandates, combined with extensive tax incentives and subsidies, have powered the market growth in parallel with the country's fast-growing economy. Industry in particular feels pressure to meet binding energy intensity targets set at the national, sub-national, sector, and enterprise levels. So far, tax incentives and financial rewards are only available for shared savings contracts in which the ESCOs provide significant upfront financing from their working capital. ESCOs provision of the upfront capital outlay has encouraged customers to overwhelmingly favor shared savings contracts where they have no upfront capital outlay over other contract types. Thus, the policy has fostered robust growth in shared savings contracts. As ESCOs are a young industry in China, the shared savings model has played a deciding and effective role in cultivating ESCO industry growth. However, the approach, in the long term, would create greater financial challenge in the EPC market as much of the low-hanging fruit is "picked" and ESCOs reach the limit of their working capital. This underscores an emerging opportunity to aggressively pursue alternative EPC financing and contracting approaches that requires new policy to support innovation in business models, financing arrangements, and expansion into untapped sectors. The drivers for the U.S. market are government and institutional; efficiency targets and programs; stakeholder-led M&V rules; and standardized contracting approaches—as well as financing. These drivers are closely linked, as the majority of projects have emerged as a result of public or institutional targets for energy efficiency. These changes are also closely coupled with the adaptation of procurement rules to allow for experimentation in lower cost, more flexible project structures, compared to what used to exist in the United States. The flexibility in choice of optimal contract structure has proven to be key in expanding the ESCO market over time, particularly after the first stage of EPC growth in the 1980s and early 1990s left many ESCOs with little remaining capacity to borrow for new projects. The historical shift in contracting model—from shared to guaranteed savings—lowered project transaction and interest costs while removing the financing burden from ESCOs; though the models in the United States remain dynamic and continue to evolve to access untapped markets. If they are providing financing, ESCOs will tend to charge a high implicit interest rate to maintain the project on their balance sheet, because they have limited amounts of capital. Because of these interest rate and working capital issues, U.S. customers found that by moving away from shared savings, they are more likely to achieve deeper retrofits with more comprehensive technology solutions. Both countries can capture significant opportunities with continuing policy support and market flexibility for diverse models. Broadly speaking, in China and the United States, developing contracting approaches that attract financing at lower costs and help achieve deeper savings will create opportunities to expand EPCs.

Sectors Targeted

Due to the large scale of energy use in the industrial sector, China's ESCOs have focused on industrial retrofit opportunities. While this sector offers great opportunities for ESCOs, projects tend to require investments and host credit risk assumptions that are most suitable for only a few large ESCOs, creating greater difficulties for the majority in China of small ESCOs. Encouraging expansion of EPCs to sectors beyond industry could help the ESCO industry as a whole to capture untapped market segments such as public buildings, commercial buildings and residential apartment complexes. Government incentives—including leveraging capital markets and strong energy efficiency targets—could be instrumental in powering such an expansion, as is already happening in the industrial EPC market. In contrast, U.S. ESCO projects have focused on the government and institutional markets as one of the largest end-users of energy. Projects in the public sector are likely to be less risky for lenders because of the credit quality of most government institutions. Fueled by growing government requirements for energy efficiency and exploration of new and flexible financing vehicles, opportunities are ripe for capturing market segments beyond the public sector. Commercial and industrial projects represent good long-term opportunities for ESCO growth, as do state government facilities in those states with very small EPC markets today.

Technologies

Most projects in China are industrial retrofits focused on niche technologies or specialized solutions. This has worked very well to rapidly tap a growing market, focused on technologies such as waste-heat recovery and boilers that have relatively shorter payback. Today, however, much of the low-hanging fruit of simple industrial retrofits has been pursued, and new opportunities require larger amount of investment and integrated solutions with a range of technologies. Thus, the Chinese ESCO industry has an opportunity to capture comprehensive projects that integrate a bundle of innovative technologies, and in doing so, expand simultaneously to sectors not fully tapped—such as public and commercial buildings. Most ESCO projects in the United States are large, comprehensive retrofits involving multiple technologies. As noted, buildings host the majority of U.S. projects. These comprehensive retrofits are complex to organize, but achieve deep savings at individual facilities, blending highly cost-effective measures like lighting retrofits with longer-term measures such as window replacements and HVAC optimization.

Contracting Model

The Chinese government singularly promotes shared savings contracts through its EPC incentives. Short-term guaranteed savings contracts also exist, but they have declined in market share as the incentives have gained in popularity. Chauffage-type or energy management outsourcing contracts for energy supply have also surged in the past few years. The United States has many kinds of contract structures, depending on the client, but there is a strong emphasis on guaranteed savings projects, particularly in the federal government and state contracts. Shared savings has worked well in China to rapidly expand the market, resulting from strong government incentives and the existence of many quick-payback projects. This approach is well placed to capture the early and obvious opportunities in the market. However, the current model may have limitations in optimally maximizing long-term and deep-energy saving opportunities for the ESCO industry as a whole in China.

Shared savings contracts put tremendous pressure on ESCOs to find project financing, making them focus less on delivering deep-retrofit results. Under the shared savings model, the cost of financing for ESCOs is much higher, resulting in shorter term loans and smaller loan amounts that limit the investable capital, the number of measures installed, and the savings. At the same time, the experience in the United States has shown that the shared savings approach where the ESCO bears all technical and credit risk can be a constraining model over time. This is because ESCOs run out of credit capacity to finance new projects, and the higher interest rates that ESCOs charge clients lead to short-term, less comprehensive retrofits.[20]

The U.S. experience with a variety of financing and contractual models—including guaranteed savings with ESCOs bearing only technical risk—can help deliver deep energy savings and long-term expansion of the ESCO market. Guaranteed savings lowers transaction costs, while moving financing to the host or project developer, which typically opens new financing options and lowers interest rates. Projects with low interest rates and low transaction costs per unit of investment help make longer-term projects possible, which means more measures are potentially cost effective.[21] Transitioning to new contract models requires changes and growth in the financial market, including increased capacity and awareness of financial institutions. M&V can also play an important role in stimulating financing by standardizing payment metrics.

Role of Government in Stimulating the Market

In China, government incentives and targets have played a critical role in supporting the ESCO industry. The United States also has incentives (mostly federal and state tax credits and rebates from utilities), but most of the thrust of the government spending has been on developing tools and training to help the industry and designing contract structures to attract investment in the public sector. One reason for this difference is government budget constraints; another has been the willingness of the private sector to finance EPCs in the United States—which is related both to the EPC and ESCO industry structure and to the size of the U.S. financial market. It is important to note that in the United States, the ESCO industry has adapted to the needs of financial markets, so many ESCOs have consolidated to become large, stable companies that financial institutions have confidence in. Meanwhile, financial markets have also evolved to provide more products and solutions to the industry. China also is keenly interested in finding ways to lower the cost of its energy efficiency programs while maintaining or increasing the energy savings impact.

Financing Mechanisms

Many ESCOs finance EPCs in China from their own working capital. There are several reasons for this, but two in particular are: (1) lack access to third-party finance by small ESCOs, and (2) government incentives that apply when ESCOs provide financing. Because ESCOs tend to rely on their own working capital for project finance, they tend to keep project sizes small and terms short, which in turn prevents ESCOs from taking on deep retrofits. Although there are cases in China where ESCOs have explored other financing vehicles, bank

[20] ESCOs typically have a higher implicit interest rate in the money they invest in EPCs than banks because ESCO working capital is scarce. High interest rates mean that projects must be shorter term to remain cost-effective, and this in turn limits the potential measures that ESCOs are willing to invest in (or stated another way, ESCOs with high implicit costs of capital will likely only be willing to invest in short payback measures).

[21] Transaction costs can inhibit retrofits, and in particular deep energy savings retrofits, in several ways. Small projects typically have higher transaction costs (per unit of investment) than large or bundled projects. Shared savings can result in disputes over exact savings levels, particularly as project terms increase, which creates both risk and cost. Transaction costs act like an additional fee, which lowers returns and makes it harder for some measures to pass the project return on investment threshold. In addition, high initial transaction costs can discourage EPCs.

loans to ESCOs are the dominant form of third party financing. In the United States, customers are more likely to take on financing or use forfaiting, in keeping with the guaranteed savings model. There are a range of financing options in use in the United States, including bank loans, forfaiting, leasing, and bonds, among others. Energy efficiency financing is a rapidly developing field (see references in Appendix G for more information). Importantly, current interest rates for EPCs in the United States also tend to be much lower—in part because of the prevailing interest rate environment—but the spread between government bonds and EPC financing can be even smaller in the United States. For example, in the State of Maryland, the cost of financing equals yield on state bonds in most projects (approximately 3.5% annually).

M&V

M&V protocols are key to EPCs because they help determine performance. Measuring pure savings seems simple, but it is not realistic as a contract obligation. Many factors unrelated to the EPC measures can affect performance including weather, occupancy rates, hours of use, production volumes, etc. M&V protocols have helped build credibility for the EPC market by making customers and financiers feel comfortable that the savings promised are measureable, and clear rules exist for assessing changes in condition that affect consumption. The IPMVP and derivative documents such as the ASHRAE and FEMP standards play critical roles in the U.S. EPC market.[22] These protocols and standards have broad scope and allow for many unforeseen changes in baselines, building the framework needed for developing deep retrofit projects. China has also adopted recommended rules for M&V and is developing guiding standards on specific equipment and systems. However, they are much more targeted and may not have the broad scope necessary for comprehensive measures. Finding ways to realistically apply these protocols as contract obligations is also a challenge. M&V standards with a limited scope may create a few challenges. First, the rules may be adequate for single-measure, highly profitable retrofits, particularly when incentives boost profitability. However, with deeper retrofits, condition changes can have a larger impact on cost-effectiveness and savings because the savings are deeper and margins are smaller. This effectively means that they primarily are useful for small and quick shared savings contracts, and as such, may limit innovation in the market. The standard may also make it difficult to do projects in facilities that have complicated baselines, or where the baseline becomes complicated after project commissioning—which may be hard to foresee. China has begun work to develop new M&V rules.

Recommended Directions

Both China and the United States have several goals in improving energy efficiency through ESCOs and EPCs. In this section, we outline these goals and our recommendations to each country based on their current EPC markets.

1: Deepen and expand the ESCO market in each country.

- China: Tremendous opportunities exist to deepen retrofits. Government policies and incentives may consider encouraging contracting models that foster deployment of technology integration, deep retrofits, including through guaranteed savings that encourage greater greenhouse gas emissions reductions.

[22] Some states such as California have also adopted M&V standards linked to IPMVP.

- China: Consider adopting policy measures to expand its EPCs beyond industry to other building types with proven records of success for EPCs in many countries, including the United States.
- United States: Consider expanding EPCs to new states and untapped markets. It can also seek to find new ways to tap industrial facilities and commercial buildings markets.
- United States: Also consider providing enhanced targets and incentives to promote deep energy savings retrofits and leverage large-scale market-based financing.
- Residential retrofits are important in both markets. The United States is developing new business models; further scale-up and credit data development and organization are needed.

2: Make the market work towards your advantage. Develop financing and contract models that attract investment at lower costs in both countries.

- China: Allow tax incentives, rewards, and M&V guidelines to support models other than shared savings, including guaranteed savings.
    - Encourage dialog between industry, customers, and government rule makers to maximize incentive/subsidy program impact and advantages.
    - Expand M&V guidelines to cover a wider range of project situations; create strategies to make realistic use of government M&V guidelines in meeting contracting obligation.
    - Develop reliable systems for measuring energy savings and create effective baselines to ease the implementation of deep-retrofit EPCs.
- China: To facilitate third party financing to host owners, develop a public national credit rating system and necessary standards/criteria for independent audit firms who certify the financial accuracy of host financial statements.
- China: Create diversified and innovative financing vehicles to encourage deeper savings, and project aggregation mechanisms to further reduce transaction costs and achieve scale.
- United States: Encourage continued innovation in financing to unleash residential and commercial markets to expand approaches to low-cost project bundling.

3: Lead through example in the public sector.

- China: Stimulate investment in the public sector by adapting government procurement policy and budgetary procedures to the needs of EPCs.
    - Allow facilities to retain their energy budgets for the entire period of performance to repay contracts.
    - Ensure that procurement policy streamlines EPCs—for example, by explicitly allowing EPCs, and by allowing for 2-stage tendering (i.e., to allow ESCOs to conduct investment grade audits). Consider Super EPCs to further streamline contracting for public facilities.
- United States: Encourage more states to consider EPC-friendly procurement policies; hold consultations with ESCOs on ways to make these smaller markets more attractive to EPCs, given the higher initial transaction costs of working in small markets.

4: Enhance U.S.-China cooperation to stimulate markets.

- Use pilot projects to test new concepts.
    - Recommend that the pilot include multi-measure retrofits that deliver deep savings and some or all of the following elements: guaranteed savings, more extensive and detailed M&V requirements sufficient to support comprehensive retrofits, and third-party financing borne by a special purpose vehicle or host owner.

    - Consult with Working Group to confirm areas of interest, in particular the focus on buildings (i.e., public buildings, commercial buildings) versus industry.
- Use the EPC Working Group to build mutual understanding and strategies around feasible models for contracting, financing, M&V, and on important policy issues.

Conclusions

Improving the efficiency of existing facilities, production processes, and systems is crucial in reducing energy use and greenhouse gas emissions, and improving economic efficiency. EPCs are important in unlocking financing and technical know-how for energy efficiency. By pursuing EPCs, ESCOs in both the United States and China play increasingly important roles in achieving energy efficiency retrofits in buildings, industry, and other types of facilities. Despite differences in market structure and stage of development, ESCOs in both countries have significant room to expand EPCs in deeper energy savings retrofits and developing market share in sectors not yet fully tapped—such as public, commercial, and possibly residential buildings for China, and industrial, residential, and commercial buildings for the United States. Both countries have complementary strengths in developing EPC markets, making EPCs a good area for collaboration between the two countries to share valuable insights and lessons learned in financing, contracting, technologies, project development, risk management, and M&V.

It is important for both countries to seek continuing policy support and greater market flexibility in developing innovative financing to attract investment at lower costs and to trigger technology integration focused on deep energy savings. Such innovation will create tremendous opportunities to expand EPCs and unleash energy efficiency retrofits in both countries.

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APPENDICES

Appendix A. Recent ESCO-Relevant Initiatives in China by International Donor Agencies

Period	Project Name	Sponsoring Organization	Goal	Project Content	Types of Assistance	Status
2008-2010	China Energy Efficiency Financing Project (CHEEF）	World Bank, GEF	To promote energy efficiency and greenhouse gas emission reduction, improve energy efficiency financing mechanisms, improve the energy use in large and medium-sized industrial enterprises, and enhance the capability of policy-making and implementation	Lend to industrial enterprises and/or energy service companies for energy conservation investment projects	Dedicated EE credit lines provided to the government of China which are on-lent to the two participating financial intermediaries (PFIs): Export-Import Bank of China and Hua Xia which, in turn, on-lend to end-use	Completed
2006-today	China Utility-Based Energy Efficiency Finance Program (CHUEE)	IFC	To increase overall investments in Industrial energy efficiency via two mechanisms: a partial risk sharing mechanism, and technical assistance for local finance partners, ESCOs, and end-users	Partial risk guarantee, technical assistance for local financers, ESCOs and industrial end-users, and market outreach via information dissemination	As of September 2012, IFC has provided the risk guarantee for a total amount of $800 million of loan lent by local FI	Active

	Energy Efficiency Multi-project Financing Project	Asian Development Bank (ADB)	Help meet government's priority of achieving energy efficiency in buildings and enable a large number of energy end users to improve efficiency by benefiting from access to finance	Support partner banks to improve the structuring, credit evaluation and monitoring of energy efficiency loans. Under this program, Johnson Controls will assist partner banks in identifying potential energy-saving projects, carrying out technical due diligence, and monitoring actual energy savings	The program involves the issuance by ADB of up to CNY800 million in partial credit guarantees in favor of selected financial institutions (partner banks) to develop energy efficiency financing	2013-2015 Technical assessment
2014-2017	Hebei Energy Efficiency Improvement and Emission Reduction Project	Asian Development Bank (ADB)	Improve energy efficiency and emission reduction in Hebei Province	Increased investments and enhanced capacity to improve energy efficiency in the industrial sector in Hebei Province	ADB offers $100 million of loan and allows Hebei to finance more projects via revolving use of ADB loan	Active
2012-	Green Intermediate Credit Project	German KFW	Support for energy conservation projects of SMEs	Energy conservation projects of SMEs	German KFW offers € 42 million of loan, German Government provides discount support	Active
2010-	China-France Green Intermediate Credit Project Phase II	French Development Agency (AFD)	To improve energy efficiency in industrial enterprises	Support renewable energy and energy efficiency projects in industrial enterprises	French Development Agency and French World Environment Fund offers a loan of € 120 million	Active

Appendix B. Major EPC Industry Events and Groups in China

The ESCO industry in China organizes and/or participates in a number of major groups and events.

Networks

- *China Energy Service Industry Net* is a member-based portal of connecting stakeholders in ESCO industry and facilitating sharing of policy, market, and technology information to advance ESCO business development. (http://www.china-esi.com/)
- *China Energy Services Industry Financing and Investment Platform* is a centralized web portal of connecting investors and ESCOs. (http://www.emca.cn/bg/rzfw/index.aspx)
- *China Energy Service Industry Technology and Product Reference System* serves as a central portal for ESCO related technologies, solutions and products. (http://tech.emca.cn/)
- *EMCA ESCO expert committee* consists of government officials, experienced researchers, and industrial executives to offer advices for ESCOs.
- *Energy Conservation Profession Union* is a professional network in the field of energy efficiency. (http://www.cecpu.cn/)
- *ESCO Committee of China Energy Conservation Association (EMCA)* is the industry group operating as a sub-association of the China Energy Conservation Association. Since its establishment, EMCA has played a key role in promoting EPC. (http://www.emca.cn)

Events

- *China Energy Conservation Service Industry Annual Summit* is the most important and well attended annual event for China's ESCO industry. It provides an effective platform for policy discussion, exchanges of energy savings technologies and best practices, and building a expanded network for all relevant players. (http://www.emca.cn/2013/)
- *China Energy-Saving Service Industry Investment and Finance Forum* is an annual event that provides an effective platform for investors, ESCOs, and other stakeholders to meet and seek collaboration.
- *EMCA Annual ESCO Survey* aims to help EMCA and policy-makers better understand the ESCO market including barriers and the market players.
- *EMCA Energy Services Industry Trainings* provide both regular and specific trainings to ESCO industry professionals covering a wide range of topics and targeting special groups of professionals related to ESCO and EPC. These trainings include not only general topics focusing on policy, financing, and technologies but also special ones such as EPC taxation and financial management, energy auditing, EPC project management, and M&V. (http://training.emca.cn/)
- *EPC Excellent Project Case Set* is an annual event aimed at gather and share the best practices in carrying out EPC projects
- *ESCO Finance and Investment Salon* is a series of discussion focusing on specific topics relative to ESCO financing. (http://about.emca.cn/n/20130318112845.html)

Appendix C. Additional Information Sources on ESCO and EPC in China

For more information about concepts and information presented in this report, refer to the additional resources below.

ESCO Industry Development: Status and Market Activities

- China Machinery Marketing Academy (CMMA), "*Analysis of the Development Status and Prospects of Chinese Building Energy Efficiency Service Industry*," 2011: Development status, prospects and expected measures of Chinese building energy efficiency service industry. Available online at http://wenku.baidu.com/link?url=23bHHki7J0hM4eAo5wq_y9dTRjtV08PgLz5-JQMdkiEQG1g4TiUfsmpe_3s8uuZRbt-Q5zX8WR7EIBbDcqsozwcKQZRePSggkwm9OnhpDZe.
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Energy-saving Plan

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Appendix D. Supplementary Information on EPC and the ESCO Industry in China

Current Energy Performance Contracting and ESCO Market in China

Despite rapid growth, the ESCO sector is still in an early stage of development in China. By the end of 2011, there were a total of 2,339 registered ESCOs[29] that together employed 378,000 people. Many of these ESCOs have been recently established, with 1,116 companies (or 47.71%) set up in 2010 and 2011. Most ESCOs (71.57%) registered with NDRC were established within the past five years. Combining both registered and unregistered ESCOs, there are currently more than 4,000 ESCOs doing businesses in China (EMCA & IFC 2012).

Based on EMCA's 2014 ESCO industry survey, 3,123 out of 3,242 registered companies have reported their services areas. Among those responded, about 1,500 companies, accounting for 48% of the total, only provide services focusing on industry while 764 enterprises focus their services only on buildings, accounting for 24.46% of the total responded. There are 298 companies providing both industry and building services (EMCA, 2014).

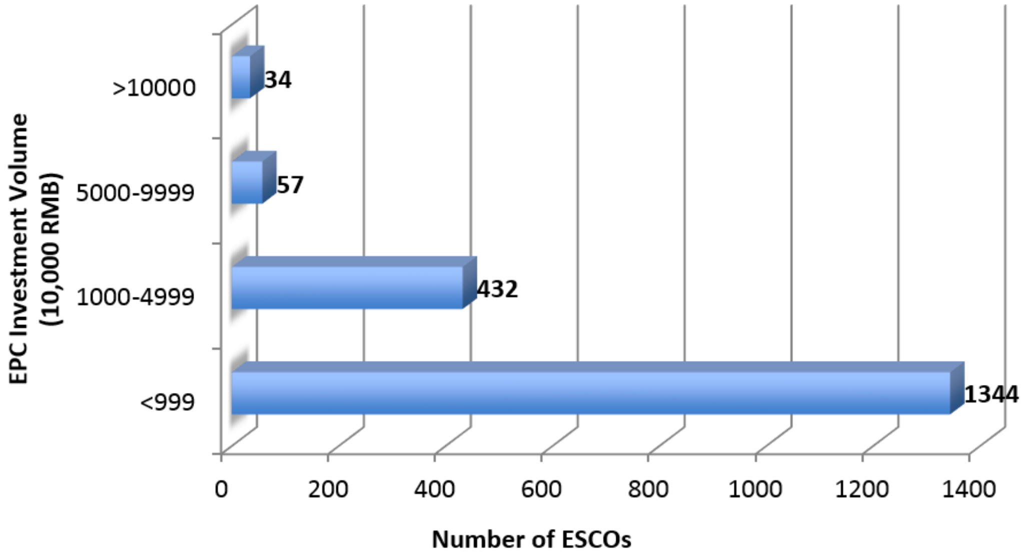
According to its annual member company survey carried out in 2012 by EMCA (China's ESCO industry association), total registered capital of the 2,339 ESCOs is about CNY 37.95 billion (approximately US$6.3 billion). Among these ESCOs, 1,357 companies (58%) have registered capital below CNY 10 million (about $1.67 million[30]). Only 73 companies (3.12%) have registered capital of more than CNY 60 million ($10 million). Similarly, most ESCOs possess small assets. 1,127 ESCOs (about 48%) have total assets of less than CNY 10 million ($1.6 million) while only 209 companies (less than 9%) have an asset value greater than CNY 60 million ($10 million). With limited assets and capital, China's ESCOs are fairly small in size and most can only be categorized as SMEs or even micro enterprises (EMCA & IFC 2012).

According to the most recent EMCA survey, total investments in EPC by the 1,866 registered ESCOs reporting their EPC project investment was CNY 26.39 billion (US$4.4 billion) in 2014. Among these ESCOs, 34 ESCOs had investment over CNY 100 million. These 34 companies together invested CNY 9.14 billion (US$1.52 billion), accounting for 35% of all reported investment. Investment made by 91 ESCOs (5% of all reported ESCOs) accounted for a half of all reported investment (EMCA 2014). Figure 6 below shows the number of ESCOs at different investment levels while Figure 7 shows the performance results achieved through energy performance contracting (EPC) in China from 2005 through 2013.

[29] The National Development & Reform Commission (NDRC) requires that ESCOs register with NDRC in order to be qualified for the Ministry of Finance's energy-saving project incentives offered to ESCOs. Details about this incentive are discussed in the sub-section on financial mechanisms.

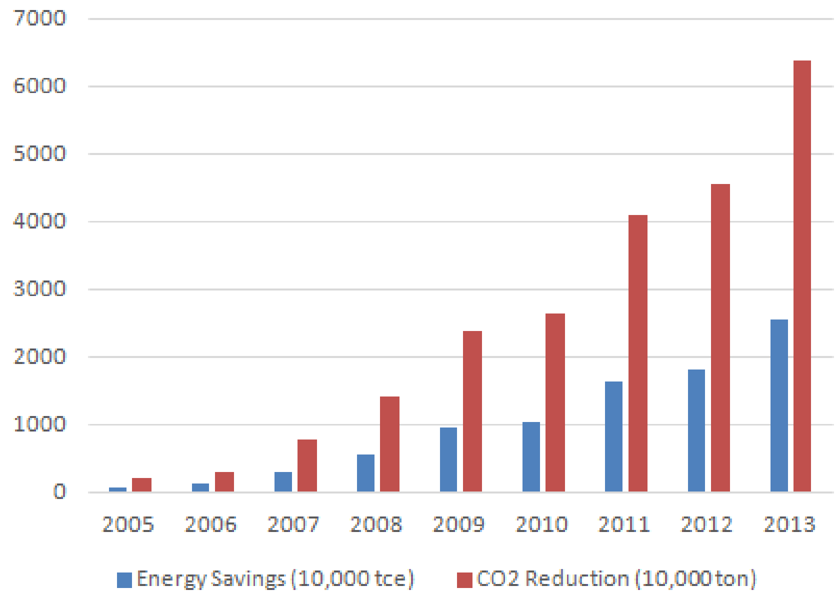
[30] This paper uses a current rate of 6:1 to convert CNY to USD.

Figure 6. Number of ESCOs at Different Investment Levels



Source: EMCA 2014

Figure 7. Energy Saving and CO_2 Emissions Reductions Achieved via EPC Projects



Sources: EMCA & IFC 2012; GBPN 2013; CESI 2014

Contracting Arrangements

Currently, there are three common types of contracting arrangements for EPC in China: shared saving, guaranteed saving, and outsourcing of energy management. Table 12 provides a brief explanation of these three models.

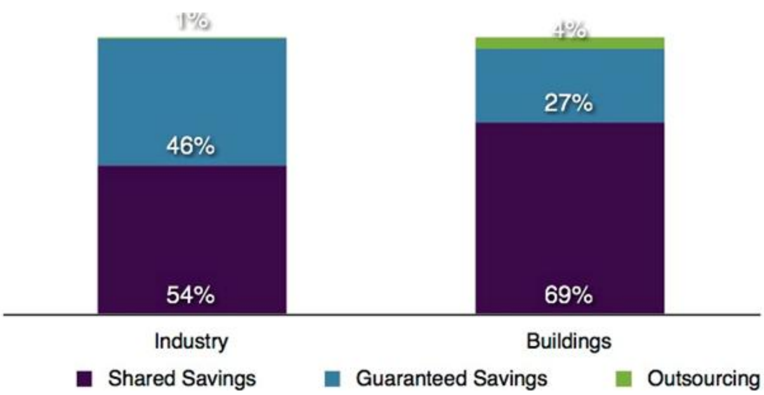
Table 12. EPC Models in China

Type of Contracting Arrangement	Definition
Shared saving	The ESCO provides the project financing and is paid by the host for a share of the energy cost savings resulting from the project. The assets received from the project are owned by the ESCO until the contract is fulfilled and are then transferred to the host without additional payment.
Guaranteed saving	The host provides the project financing and owns the asset. The ESCO provides project design and implementation and at the same time guarantees the energy savings. The ESCO will have specified consequences related to performance, such as penalties if they fail to achieve the contracted savings.
Outsourcing of energy management	The ESCO invests and develops the project, owns it, and operates it throughout the contracting period. The ESCO's return could be agreed in contract signing or linked to the energy-savings achieved or energy delivered. Example includes waste heat recovery projects.

Source: EMCA&IFC 2012

Even though recent information is not available from public sources, EMCA's member company surveys from 2007 to 2009 reveal how the three contracting models were applied respectively in the industrial and building sectors. As shown in Figure 8, during 2007-2009, the shared savings contracts in industry accounted for only 54% of total projects while guaranteed savings accounted for 46%. However, about 70% of the total projects in the building sector used the shared savings model.

Figure 8. Share of EPC Projects of EMCA Members by Contracting Types, 2007-2009



Source: Sun et al., 2011

Policy Support

The Government of China has adopted a series of policies to develop the ESCO industry and promote EPC (see Table 13). In the public sector, China's State Council issued the *Public Sector Energy Conservation Rule* in 2008, which established specific rules and requirements for the public sector to conserve energy and improve energy use in public institutions. Among many requirements, this State Council directive requires that energy use thresholds (i.e., energy use per square meter) based on region and building type be developed and that the government financial offices use the thresholds to determine the allowance for payment for energy use by public institutions.

Table 13. Major Laws and Directives to Promote the ESCO Industry and EPC in China

Time	Authority	Policy	Note
Jul. 2006	NDRC and 7 other ministries and national commissions	*Opinions on the Implementation of the Top 10 Major Energy Saving Projects during the 11th FYP*	Encourages the adoption of EPC for carrying out major energy saving projects
Jun. 2007	State Council	*Comprehensive Work Plan for Energy Saving and Emission Reduction*	Establishes guidelines for accelerating the development of the ESCO industry
Oct. 2007	People's Congress	Amended *Energy Conservation Law*	Includes "supporting the promotion of the EPC mechanism" in the law
Oct. 2008	State Council	*Public Sector Energy Conservation Rules*	Established rules and requirements for the public sector to save energy and improve energy efficiency in public institutions; the directive allows public institutions to hire ESCOs to carry out energy efficiency measures via EPC.
Apr. 2010	State Council (jointly with NDRC, Ministry of Finance, People's Bank and State Taxation Administration)	*Opinion on Expediting the Implementation of EPC for Promoting the Development of the ESCO Industry* (GBF (2010) No. 25)	Emphasizes the importance of accelerating the use of EPC and promoting the ESCO industry
Jun. 2010	Ministry of Finance and NDRC	*Notice on Intermediate Measures of Issuing Financial Incentive Management Fund for EPC*	Offers financial incentives to support ESCOs using EPC

Oct. 2010	State Council	*Decision on Accelerating the Development of Emerging Strategic Sectors*	EPC included as one of the strategies for the development of China's emerging sectors such as the energy service industry
Dec. 2010	Ministry of Finance and State Tax Administration	*Notice on Policy Issues of Value-added Tax, Business Tax, and Business Income Tax for Promoting the Development of the ESCOs Industry* (CS (2010) No. 110)	Establishes special tax treatment for encouraging ESCOs to carry out EPC projects
Aug. 2011	State Council Government Administration Bureau	*Public Institutions Energy Conservation Plan in the 12th FYP*	Calls for the greater use of EPC to improve energy use in the public sector
Jul. 2012	State Council	*Notice of the State Council on the Issuance of the 12th Five-Year Plan (FYP) Energy Saving and Environmental Protection Industry Development Plan*	Calls for accelerated development of the ESCO industry and encourages greater applications of EPC
Jan. 2013	State Council (jointly with NDRC and MOHURD)	*Announcement of Green Building Action Plan*	Promotes the use of EPC in retrofitting government buildings and public institution buildings

Appendix E. Ongoing EPC Initiatives by U.S. Federal Government, States, Commercial Sector, and Industry

The following initiatives exist in the United States to support EPCs:

- *Federal Energy Management Program (FEMP)* is a program of the U.S. DOE that manages the contract structure of EPCs for federal facilities. FEMP also provides numerous resources and training on EPC procurement and implementation. (http://energy.gov/eere/femp/federal-energy-management-program).
- *The Energy Service Coalition* (ESC) is a public private partnership consisting of energy efficiency experts, government representatives, industry, and building owners dedicated to promoting the use of energy performance contracting in public and private facilities. (http://www.energyservicescoalition.org/).
- *The Federal Performance Contracting Coalition* (FPCC) is an organization advocating for increased federal use of EPCs, consisting of ESCOs that represent 90 percent of federal EPCs. (http://federalperformancecontracting.com/).
- *National Association of Energy Service Companies* (NAESCO) is a membership-based trade organization promoting the energy efficiency industry in the energy marketplace, the media, and the government. (http://www.naesco.org/).
- *Better Building Alliance* a U.S. DOE effort to promote energy efficiency in U.S. commercial buildings through working with building owners, operators and managers. Members commit to addressing energy efficiency needs in their buildings by setting energy savings goals, developing resources, and adopting cost-effective technologies and practices. (http://www4.eere.energy.gov/alliance/).
- *Green Bank of Kentucky Program* is an initiative by the state of Kentucky to provide state agencies with low-interest loans for energy efficiency purposes. One of the three loan products are EPC Revolving Loan. (http://finance.ky.gov/initiatives/greenbank/Pages/default.aspx).
- *Massachusetts's Energy Performance Contracting Program* is a state initiative to design and install conservation measures in existing state facilities through EPC. (http://www.mass.gov/anf/property-mgmt-and-construction/facilities-mgmt-and-maintenance/energy-and-sustainability/energy-performance-contracting-program.html).
- *Maryland's Department of General Services* supports EPCs in state buildings, while also running an annual 16 Agency Energy Competition, in which participating agencies aim for the largest percent reduction in energy consumption. (http://www.dgs.maryland.gov/energy/AgencyCharts/index.html).
- *U.S. DOE Weatherization and Intergovernmental Program* offers resources, grants and technical assistance to states, local governments, communities, utilities, Indian tribes and overseas U.S. territories for their energy programs, including EPCs. (http://www1.eere.energy.gov/wip/solutioncenter/technical_assistance_resources.htm)

Appendix F. Major EPC Industry Events and Groups in the United States

The ESCO industry in the United States organizes and/or participates in a number of major groups and events.

Networks

- *ASHRAE* is membership-based association with focus on building systems, energy efficiency, indoor air quality, refrigeration and sustainability within the industry. The organization publishes well-recognized series of standards and guidelines relating to HVAC systems that are cited in the U.S. building codes, but the organization also has international influence. (http://www.energyservicescoalition.org/financing).
- *The Energy Service Coalition* (ESC) is a public private partnership consisting of energy efficiency experts, government representatives, industry, and building owners dedicated to promoting the use of energy performance contracting in public and private facilities. (http://www.energyservicescoalition.org/).
- *The Federal Performance Contracting Coalition* (FPCC) is an organization advocating for increased federal use of EPCs, consisting of ESCOs that represent 90 percent of federal EPCs. (http://federalperformancecontracting.com/).
- *National Association of Energy Service Companies* (NAESCO) is a membership-based trade organization promoting the energy efficiency industry in the energy marketplace, the media, and the government. (http://www.naesco.org/).
- *Efficiency Valuation Organization (EVO)* is an organization started by M&V professionals at U.S. DOE to develop an international M&V protocol. (http://www.evo-world.org).

Events

- *ESC Annual Market Transformation Conference* gathers public and private sector participants to facilitate sharing of best practices to advance EPCs. (http://conference.energyservicescoalition.org/)
- *NAESCO Annual Conference* is one of the major ESCO industry events that takes place in November. The conference gathers policymakers, regulators and ESCO leaders. (http://mojo.naesco.org/naesco-events).
- *Energy Efficiency Global Forum* is a major international event on energy efficiency held in Washington, DC, by the Alliance to Save Energy. The agenda usually includes EPC-related discussions. (http://eeglobalforum.org/).
- *American Council for an Energy-Efficient Economy (ACEEE) Energy Efficiency Finance Forum* draws investors, financiers, policymakers and companies. Many topics are EPC related. (http://www.aceee.org/conferences/2014/eeff).
- *2014 Better Buildings Summit* is a national summit hosted by U.S. DOE to catalyze investment in energy efficiency across the public, private, commercial, industrial and residential sectors. Agenda includes discussion of EPC mechanism. (http://www1.eere.energy.gov/buildings/betterbuildings/summit/).

Appendix G. Additional Resources: Leading Reports and Case Studies in the United States

For more information about concepts and information presented in this report, refer to the additional resources below.

Contracts and Procurement

- Celtic Energy, "*Best Practices Guide for Energy Savings Performance Contracting (ESPC) in the Municipal, University, School, and Hospital Markets*," 2011: A comprehensive guide to the EPC procurement process with sample contracts, worksheets, and forms. Available online at http://www.celticenergy.com/espc-best-practices-guide-for-energy-savings-performance-contracting.html.
- Department of Energy (DOE), "*Federal Energy Management Program*," 2014: A resource for EPCs in the federal government; provides links to regulations, funding resources, technologies, and more. Available at http://energy.gov/eere/femp/federal-energy-management-program.
- The Energy Service Coalition, (ESC): "*Resources. Case Study Database*," 2014: A database of about 600 case studies of EPCs in the federal, state, local, and private sectors with filters that allow selecting by ESCO, state, sector category, technology, and financing source. Available online at http://www.energyservicescoalition.org/casestudies.
- Pacific Northwest National Laboratory (PNNL), "*A Guide to Performance Contracting with ESCOs*," 2012, PNNL-20939: An introductory guide to concepts and procurements of EPCs in the public and private sectors. Available online at http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-20939.pdf.

Financing

- The Energy Service Coalition (ESC), "*Resources. Project Financing Options*," 2014: A list of several banks and other resources in the United States that offer EPC financing. Available online at http://www.energyservicescoalition.org/financing.
- International Energy Agency's Demand Side Management Task XVI, "*Financing Options for Energy-Contracting Projects –Comparison and Evaluation*," 1995: A detailed explanation of financing options with examples from outside of the United States. Available at http://www.ieadsm.org/Files/Tasks/Task 16 - Competitive Energy Services %28Energy Contracting, ESCo Services%29/Publications/101126_GEA-T16_Finance Options for Energy-Contracting incl Examples.pdf.
- Wilson Sonsini Goodrich & Rosati, "*Innovations and Opportunities in Energy Efficiency Finance*," 2013: A review of the latest developments in energy efficiency finance in the United States. Available at http://www.wsgr.com/publications/PDFSearch/WSGR-EE-Finance-White-Paper_13.pdf.

Measurement and Verification (M&V)

- ASHRAE, "Guideline 14-2002 – Measurement of Energy and Demand Savings," Available for purchase at: http://www.techstreet.com/ashrae/products/1645226.
- Department of Energy, "*M&V Guidelines: Measurement and Verification for Federal Energy Projects. Version 3.0*," 2010: A comprehensive guide to M&V for federal facilities. Available online at https://www1.eere.energy.gov/femp/pdfs/mv_guidelines.pdf.

- Efficiency Valuation Organization (EVO), "*International Performance Measurement and Verification Protocol*": A comprehensive guide to M&V for all facilities. Available for free download at http://www.evo-world.org/index.php?lang=en.
- Lawrence Berkley National Laboratory (LBNL), "*Measurement & Verification Portal,*" 2013: Online resource with links to M&V documents, tools, and guidelines. Available online at http://mnv.lbl.gov/home.

Policy and Outreach

- Lawrence Berkley National Laboratory (LBNL), "*Current Size and Remaining Market Potential of the U.S. Energy Service Company Industry*," 2013, LBNL-6300E: An analysis of the market size, growth projections and industry trends of the U.S. ESCO industry. Available for free download online at http://emp.lbl.gov/sites/all/files/lbnl-6300e_0.pdf.
- Maryland State Administration and Catalyst Financial Group, Inc., "*Getting to "YES": A Guide to Developing a Persuasive Business Case for Energy Efficiency in Commercial Buildings*," 2013: Practical suggestions for communicating and convincing stakeholders of the benefits of energy efficiency upgrades, including through EPCs . Available online at http://energy.maryland.gov/Business/businesscaseguide/documents/YesforEnergyEfficiencyGuide.pdf.
- U.S. Environmental Protection Agency (EPA), "*Introduction to Energy Performance Contracting*," 2007: A report on the ESCO industry context in the United States. Available at http://www.energystar.gov/ia/partners/spp_res/introduction_to_performance_contracting.pdf

Public Sector

- Department of Energy (DOE), "*ESPC IDIQ Contract Sample*," 2012: A sample indefinite delivery, indefinite quantity (IDIQ) energy savings performance contract (ESPC) awarded to Energy Service Companies (ESCOs) working in the public sector. Available for free download online at http://energy.gov/eere/femp/downloads/espc-idiq-contract-sample.
- Oak Ridge National Laboratory (ORNL), "Reported Energy and Cost Savings from the DOE ESPC Program," 2010: A summary and analysis of DOE EPC projects and savings. Available at http://btric.ornl.gov/pdfs/femp_reported_espc_savings_12-1-10.pdf.
- The Energy Service Coalition (ESC), "*Resources. Best Practices and Tools*," 2013: A description of best practices and tools for States developing and implementing EPCs. Available for free download online at http://www.energyservicescoalition.org/resources/tools/.

Tools

- Facility Energy Decision System (FEDS) analyzes the energy efficiency of single or multiple buildings and identifies energy efficiency measures using minimum life-cycle costs and payback period. It allows users to input very little or very detailed data, depending on what is available. PNNL originally designed the tool for federal facility managers; today facility managers in both the public and private sector use FEDs in EPC decisions. (http://www.pnl.gov/feds/).
- Several tools simulate energy use and analyze energy consumption, including eQUEST (http://www.doe2.com/equest/) and BuildingAdvice (http://www.airadvice.com/). More

complex load calculation tools include EnergyPlus (http://apps1.eere.energy.gov/buildings/energyplus) and Energy Pro (http://www.energysoft.com/main/page_energypro_ep_information.html) .

- Saving estimators can propose capital investments to reduce operating costs of buildings or buildings systems, including evaluating energy and water conservation projects in buildings, such as BLCC5 (Building Life Cycle Cost Program) and up-to-date standard financial and technical information that feeds into calculating savings for EPCs. Examples include Energy Escalation Rate Calculator and Handbook 135 and its annually updated supplement. The Handbook details the principles of life cycle cost analysis of life cycle cost analysis and integrates them with FEMP criteria, whereas the supplement provides the latest Energy Price Indices and Discount Factors. (http://www1.eere.energy.gov/femp/information/download_blcc.html).
- Location-specific analyses: For example, Federal Renewable Energy Screening Assistant (FRESA) (https://www3.eere.energy.gov/femp/fresa/) assists in identifying renewable energy technologies appropriate for implementation; RE Atlas (http://maps.nrel.gov/re_atlas) can help identify the most abundant renewable-energy resources.
- Market survey and project databases: Online tools, such as the ESCO Project Analysis and Reporting System (E-PARS) (https://oahu.lbl.gov/esco/login.html), which collects information about EPCs, enabling agencies to perform market analyses. eProject Builder (https://eprojectbuilder.lbl.gov/), a new system, superseded E-PARS in June 2014. DOE finances this database to serve as a clearinghouse for ESCO projects across all levels of government.