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Full Report with Executive Summary

on

International Experience with Energy Service Providers in the Industrial Energy Efficiency Market

Prepared to Support the Development of Energy Efficiency Services for Turkey's Industrial Sector

Prepared for the Government of Turkey/ UNDP/ UNIDO/ GEF
Improving Energy Efficiency in Industry (IEEI) Project

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Executive Summary

i. Introduction

- This study reviews international experience with energy service providers (ESPs) in energy efficiency with emphasis on the industrial sector. This document is a summary of findings, which are presented in more detail in a longer, full report.
- The purpose of the study is to provide insights useful to Turkey in strengthening its industrial ESP sector.
- Special challenges in this work are:
  - The energy efficiency field lacks clear-cut boundaries and overlaps with other fields, making classification of ESPs difficult.
  - Industrial sector ESPs differ from those serving government, institutions, and commercial buildings; and less information is available on them.
  - The definition of ESCO is used differently by different sources.

Energy service providers (ESPs) – the Broad Group

- The term "energy service provider" (ESP) refers to the broad group of companies providing energy efficiency services and related energy services to customers.
- This report chooses to use the term energy service provider (ESP), because (1) the EU uses this term in its 2012 Directive on Energy Efficiency; and (2) the scope is broad enough to ensure no important groups are left out.
- "Energy efficiency service provider" is an alternative term, but may leave out relevant types of energy provision, such as CHP, and may make comparison with the ESCO market difficult.
- Delineating the energy efficiency market is challenging. The EU Directive requires member states to monitor and evaluate their energy services markets, but the requirement is qualitative rather than quantitative.
- One source divides the energy services market into three parts: (1) energy advice and audit services, (2) energy management services, and (3) energy contracting services.[1]
- This study uses three dimensions to help identify and describe ESPs working in the industrial sector:
  1. Function of the ESP, including: (a) consulting oriented services, (b) installation and construction oriented services, (c) energy provision, and (d) financing.
  2. Type of company, including: (a) small consulting firm, (b) large engineering consulting firm, (c) manufacturer or distributor of equipment facilitating energy efficiency (also provides services), and (e) ESCO.
  3. Aspect of industrial energy efficiency addressed, including: (a) industrial processes (account for largest share of industrial energy use), (b) cross-cutting equipment supporting processes (such as pumps, air compressors, fans, mixers, CHP equipment, etc.; accounts for second largest share of industrial energy use), (c) facility/building (covers heating, ventilation, air conditioning, and lighting; among these three categories, accounts for smallest share of industrial energy use).

[1] Ruth Offermann et al, *Monitoring the Energy Efficiency Services Market in Germany*, 2013.

ESCOs – a Subset of the Broad Group of ESPs

- The term "ESCO" is used in this report to refer to the subset of ESPs that are paid for their services based on performance. It excludes ESPs that are paid based on a fee-for-service basis only. The EU Directive and many industry experts use this definition of ESCO.
- ESCOs may provide financing for projects, either from their own equity or via a third party.
- The ESCO concept is seen as an attractive way to overcome client reluctance to adopt energy efficiency measures: It reduces client risk as to whether the measures will work and may allow the client to pay for the project over time via energy savings, rather than pay the full cost up-front.
- The scope of ESCO work ranges from projects specifically addressing energy efficiency (most commonly retrofits of building heating, ventilation, and air conditioning systems and of lighting) to energy supply projects, such as CHP.
- The main types and sub-types of ESCO contracts are:
  - Energy Performance Contract (EPC)*:* Contract for energy efficiency retrofit project in which payment to ESCO is contingent on achieving promised reduction in energy usage. The two main types of EPC contract are:
    - *Shared savings*: ESCO provides or arranges financing. It is paid back gradually by receiving a pre-agreed portion of the energy savings, the rest of which is retained by the client. If energy savings exceed expectations, the contract calls for the ESCO to benefit from the upside.
    - *Guaranteed savings*: Client pays for ESCO's services up-front through its own funds or bank loan. Yet, if the project does not perform, the ESCO will need to reimburse the client or assist with debt servicing. If energy savings exceed expectations, the ESCO may benefit from the upside.
  - Energy Supply Contract (ESC): Contract for supply of energy services, such as heat, electricity, or lighting. Also known as "delivery contracting." Client pays ESCO over time as energy/service is delivered. ESCO may build, pay for, and operate energy production facilities. Terms related to ESCs include:
    - *Chauffage*: Describes contract type popular in Europe whereby client agrees to pay ESCO a fee for energy or other utility services. Fee is typically based on client's existing utility bill, but with a certain level of savings.
    - *Power purchase agreement (PPA)*: In US, describes agreement guaranteeing the purchase of power for a certain price over a certain period of time. Term is much broader than ESCOs in scope. In the case of an ESCO, a CHP project or other project serving a specific facility may be structured as a PPA.
    - *BOOT contract (build-own-operate-transfer)*: Describes situation in which the ESCO designs, builds, finances, and operates the equipment for a period of time, during which there is a long-term energy supply contract with the client. After the designated period is over (and the ESCO has recovered its cost and made a profit), ownership of the project is transferred to the client.
- Terms relevant to the financing of ESCO projects include:
  - ESCO financing: ESCO provides funds for an ESCO project, either through its own funds or through a third party, typically a bank.

- Customer financing: Customer, either through its own funds or third party financing, provides the up-front funds for the project. In this case, the ESCO handles only the management and engineering for the project, taking on the technical performance risk only.
- Project finance: Form of financing whereby collateral is not required by bank, but the project is instead "guaranteed" through the expected income flows (whether they be energy savings or energy provided) of the project. In practice, banks usually require some form of collateral for energy efficiency projects, just like for standard loans. ESCO energy supply contracting, more similar to the kinds of projects seen in the project finance world, may be more likely to achieve project finance arrangements.
- Third Party Financing (TPF): May be a form of either ESCO financing (ESCO is the borrower) or customer financing (customer is the borrower). Ideally, this type of financing would be achieved through project finance, though in most countries this is difficult to achieve in practice.
- Forfeiting: Bank pays the ESCO in full after the completion of installation, in a sense buying the project for a discount. The customer then makes fixed payments to the bank over time.

- Typical barriers to the development of ESCOs and ESCO projects include:[2]
  - ESCOs' lack of access to commercial loans to finance projects and lack of project financing for ESCO projects: In new ESCO markets, small, emerging ESCOs lack collateral needed to obtain bank loans. And, financial institutions lack understanding about ESCO projects.
  - Hesitancy of customers to finance projects themselves or to even undertake ESCO-financed projects: This is a result of the industry being new, the ESCOs lacking track records, and a related low level of trust for ESCOs. Further, this is due to potential clients' lack of appreciation of the upside of energy efficiency projects in general and of ESCO projects in particular.
  - Low electricity prices: These hinder other forms of energy efficiency projects as well.
  - High transaction costs: ESCO projects entail more burdensome upfront administrative efforts and procedures to bring a project deal to closure. This is partly due to the need to verify savings. High transaction costs may result in only very large projects meriting the effort required by the ESCO model.
- Aside from the long-enduring energy supply contract (ESC) business in Europe, the emergence of ESCOs was initially sparked by the energy crisis in the US in the late 1970s. Growth since then has largely been driven by policy and provision of outside funding for energy efficiency projects.
  - In the US, at first utilities instead of end users paid ESCOs (at high rates) for projects.[3]
  - In China, availability of grants, loans, and tax credits drive the industry.
- Means of promoting ESCOs have included: (1) provide donor or government financing for projects, (2) provide funding for audits, (3) prepare standardized contracts, (4)

[2] The points below on barriers draw from Edward Vine, "An International Survey of the ESCO Industry," *Energy Policy*, 2005.

[3] Personal communication in October 2015 with Mr. Donald Gilligan, President of the US's National Association of ESCOs (NAESCO), provided strong insights into the history and drivers of ESCOs in the US, as referenced here, elsewhere in this summary, and in the full report.

conduct ESCO demo projects, (5) enact legislation (such as tax credits for ESCOs / ESCO projects and requirements that utilities achieve a certain level of energy savings), (6) increase information flow about ESCO projects and financing to potential clients (e.g. via utilities), (7) ensure ESCO services are of high quality (e.g. through accreditation programs), and (8) build knowledge about ESCOs among financial institutions.[4]

Purpose and Content of this Study

- The main target audience of the study is relevant stakeholders in the Government of Turkey, existing or potential industrial sector ESPs, and potential industrial clients of these ESPs.
- The study endeavors to provide stakeholders with information needed to develop plans and strategies for developing and utilizing industrial sector ESPs in Turkey.
- The study examines what types of companies providing what types of services have thrived in the industrial ESP markets of other countries.
- Currently, roughly 35 energy efficiency consulting companies ("EVDs") have obtained certification from the Turkish Government. Many more are believed to exist. About 18 EPCs have been conducted in Turkey to date, most by one company. It is not clear how applicable ESCOs and EPCs are to the situation of Turkey, particularly Turkish industry.
- Many industrial energy audits have been conducted in Turkey, but quality is uneven.
- The research methodology for this study includes literature review and interviews.
- The main content of this study is review of the situation of ESPs generally and in the industrial sectors of nine countries: US, China, Japan, Ukraine, Thailand, South Korea, Germany, Italy, and Great Britain. A brief review of EU ESP framework is also included.
- In selecting countries for ESP sector review, considerations included: (1) development level (with both developed and developing economies of interest), (2) large industrial sector, (3) size of country (countries with larger populations preferred), (4) size of ESCO market (larger market preferred), (5) reported role of industrial sector in ESCO market (large role of industrial sector preferred), and (6) role of small and medium sized enterprises in industrial sector (significant role preferred). Selected countries fall roughly into three groups: (a) populous, developed Western countries with relatively large ESCO markets, but with industry holding a small share in ESCO market; (b) developing countries in which industry reportedly holds a large share in the ESCO market; and (c) populous, developed East Asian countries in which industry reportedly holds a large share in the ESCO market.

ii. The US Case

US ESCO Market

- The US has for years had the world's largest ESCO market, only recently rivaled in size by China's. Industrial projects have a very small share in the US ESCSO market. (Industrial and commercial projects together accounted for only 8.1% in 2011.)[5]

[4] These points on drivers of the ESCO industry draw in part from op. cit., Edward Vine, 2005.

[5] Elizabeth Stewart et al, *The US ESCO Industry: Recent Trends, Current Size, and Remaining Market Potential*, ACEEE 2014 Summer Study on Energy Efficiency in Buildings.

- The ESCO model may not fit well with a developed industrial sector. A less modernized industrial sector, where "low hanging fruit" in energy efficiency enables shorter payback times, may be more appropriate to ESCOs.[6]
- The US ESCO market's size was USD5.3 billion in 2011.[7] It holds a minority but significant share of the overall US energy efficiency market.[8]
- The main US ESCO market is federal and local government buildings and schools and universities, together accounting for 79% of market volume in 2012.[9] The US ESCO sector is focused on building energy efficiency technologies, with heating-ventilation-and-air conditioning (HVAC) and lighting being the most popular.[10]
- Revenues of US ESCOs are mainly from EPC: In 2011, 69% of revenues were from EPCs and 3.6% from onsite power generation. The rest was from fee-for-service projects.[11]
- The average size of US ESCO projects is large: From 2005 to 2008, the average public sector project was USD6.5 million and the average private sector project, USD3.2 million.[12]
- Annual savings of US ESCO projects are said to average 20 to 40 percent. Payback times are said to be 7 to 9 years in the public sector and 4 years in the private sector (based on a 1990 to 2008 project data set).[13]
- US ESCOs emerged in the late 70s and early 80s out of energy consulting firms that had been carrying out government-sponsored audits. Early industry growth was driven by utility programs. Utilities instead of end users paid ESCOs back quite generously for energy savings. At the time, industry, with attractive paybacks for building retrofits, was the preferred customer. Currently, utility programs pay only about 25% of equipment costs. So, the customer base has shifted to those interested in paying and expected to be around for the full duration of the contracts: government and institutional clients.[14]
- Government incentive program (loans and grants), tax credits, and utility funded programs continue to be major drivers of the US ESCO industry.
- A significant portion of US ESCO projects are financed up-front by the client, especially in the private sector (50% of projects, based on one survey) and federal building sector (40%, paid upfront via government program funds).[15]
- The most significant barriers to US ESCOs occur in the private sector: Potential clients have an aversion to long-term contracts and to allocating funds to noncore business.[16]

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[6] This conclusion draws on discussion with and analysis by Mr. Donald Gilligan in Oct. 2015, op. cit.
[7]Elizabeth Stewart et al, 2014, op. cit.
[8] This conclusion draws on data from Charles Goldman et al, *Energy Efficiency Services Sector: Workforce Size and Expectations for Growth*, Lawrence Berkeley Laboratory, 2010 and from Andrew Satchwell et al, *A Survey of the US ESCO Industry: Market Growth and Development from 2008 to 2011*, Lawrence Berkeley Laboratory and National Association of ESCOs, 2010.
[9] Elizabeth Stewart et al, 2014, op. cit.
[10] Charles Goldman, "US Energy Service Company (ESCO) Industry and Market Trend," Presentation at the *Second US China Energy Efficiency Forum, 2011*.
[11]Elizabeth Stewart et al, 2014, op. cit.
[12]Charles Goldman, 2011, op. cit.
[13]Charles Goldman, 2011, op. cit.
[14]This paragraph draws from discussion with and analysis by Mr. Donald Gilligan in Oct. 2015, op. cit.
[15]Elizabeth Stewart et al, 2013, *Current Size and Remaining Market Potential of US ESCO Industry*, Lawrence Berkeley Laboratory.
[16]Elizabeth Stewart et al, 2013, op. cit.

US ESCOs

- There were 45 true ESCOs in the US in 2012.[17]
- US ESCOs typically outsource installation to the building and construction industry. ESCO staff is roughly 60% engineers.[18]
- US ESCOs can be divided into four types: (1) independent ESCOs (not owned by any parent company), (2) building equipment manufacturers (who leverage their national sales networks), (3) utility subsidiaries (who leverage their access to clients), and (4) engineering services firms. The early industry consisted of small, entrepreneurial companies. Later, the manufacturers joined them.[19]
- The US ESCO industry has consolidated, with acquisition of the majority of independent ESCOs. Among the top ESCOs, only one independent ESCO, Ameresco, remains.[20] In 2011, the 13 (of 45) US ESCOs that each had annual revenues of over USD100 million accounted for 85% of the ESCO market.[21]
- The US ESCO sector is said to be growing at a rate faster than the US economy and is believed to be a profitable industry.[22]
- The US ESCO Association, NAESCO, runs an accreditation program.[23]

US ESPs

- US ESPs may be divided into those companies that focus on energy efficiency and those for which energy efficiency is a small part of their business. The energy efficiency focused firms include a large number of small consulting firms and startups and a limited number of large engineering firms and ESCOs. Among the companies that do not have energy efficiency as their core business are design and engineering firms, equipment providers, architects, electricians, mechanical contractors, insulation contractors, and other building and construction industry companies.[24]
- A 2008 study estimates the total size of the US ESP workforce as 114,000 person-years.[25]
- Policy, especially financial incentives and building codes and standards, is believed to drive a substantial portion of the US ESP industry.[26]

US Industrial ESCO Market and US Industrial ESCOs

- ESCO activity in the US industrial ESP sector is limited. Non-ESCO fee-for-service models predominate. Together, the industrial and commercial US ESCO market was valued at US426 million in 2011.[27] Most US industrial ESCO projects are building-

[17]Elizabeth Stewart et al, 2013, op. cit.
[18]Charles Goldman et al, 2010, op. cit.
[19]Discussion with Donald Gilligan in Oct., 2015, op. cit.; Harris Williams & Co. white paper: *ESCOs – Enabling Energy Efficiency: An Introduction to Energy Service Companies ("ESCOs")*, 2010; and Navigant Consulting, *Energy Services Company Market Overview*, 2015, accessed via summary of report in Oct. 2015 at https://www.navigantresearch.com/research/energy-service-company-market-overview.
[20]Based on listing of top US ESCOs in Navigant Consulting, 2015, op. cit.
[21]Elizabeth Stewart et al, 2013, op. cit.
[22]Elizabeth Stewart et al, 2013, op. cit. on growth rate; Harris Williams & Co., 2010, op. cit., on profitability.
[23] For information on accreditation program, see: http://www.naesco.org/accreditation .
[24]Charles Goldman et al, 2010, op. cit.
[25]Charles Goldman et al, 2010, op. cit.
[26]Charles Goldman et al, 2010, op. cit.
[27]Elizabeth Stewart et al, 2013, op. cit.

focused. Some CHP projects exist and use energy supply contracts (ESCs) known as power purchase agreements.

- The ESCO model no longer works well in US industry because: (1) Facing intense global competition, industry needs to be flexible to close down plants and does not like to sign long-term contracts. Further, when paybacks are long, energy efficiency competes with investment opportunities in core business areas. (2) The building technologies on which ESCOs focus are no longer new and inaccessible. Industrial clients prefer to cut costs and do retrofits themselves. (3) ESCOs are generalists and focus on buildings. They do not have the capabilities to support industry in its largest energy consuming areas, industrial processes and cross-cutting industrial equipment. (4) US industry is focused on its core business and is more likely to hire as ESPs providers already working on its core business. (5) US industry has secrecy concerns and thus is more likely to allow its existing, trusted providers into its facilities. (6) It is more difficult to measure energy savings in industry than in buildings, making performance based models difficult to implement.[28]
- Cases of ESCOs in US industry are still to be found and are usually building focused: (1) GM recently carried out a series of building focused ESCO projects. It was motivated by the opportunity to pay back the ESCOs over time, freeing up funds for other investments.[29] (2) A company named "ESCO" has reported numerous lighting projects in industry.[30]

US Industrial ESP Market and US Industrial ESPs

- Engineering firms and equipment vendors play the greatest role in providing energy efficiency services to US Industrial clients. These ESPs work on a fee-for-service basis.[31]
- Clients that purchase these services most often are large industrial companies that have the resources to do so.
- The engineering firms include both large ones and small ones. Some very small ones may be quite specialized in a single aspect of industrial energy use.[32]
- Qualified individual specialists may also play a role as ESPs.
- Construction firms also serve industry as ESPs, specializing in a certain type of equipment, such as a hot air system or compressed air.[33]
- Some large industrial facilities may depend mostly on in-house energy efficiency personnel.[34]
- Engineering firms and equipment vendors have a number of advantages over ESCOs: (1) industrial expertise, (2) intimate knowledge of plant and processes, (3) their work not

[28]This paragraph draws from discussion with Donald Gilligan, op. cit., Oct. 2015; and Neal Elliott, *Vendors as Industrial Energy Service Providers*, American Council for an Energy Efficient Economy, 2002.
[29]Details on the GM case are taken from information provided by the US Department of Energy and accessed in Oct. 2015 at http://betterbuildingssolutioncenter.energy.gov/implementation-models/energy-performance-contracting.
[30]"ESCO's" website accessed in October 2015 at http://goesco.com and information on its clients is at http://goesco.com/clients/ .
[31]These findings were confirmed by multiple sources.
[32]Discussion with Donald Gilligan, Oct. 2015, op. cit.
[33]Discussion with Donald Gilligan, Oct. 2015, op. cit.
[34]Discussion with John Smegal, US Department of Energy, Oct., 2015; and communication with Paul Sheihing, US DoE, Nov., 2015.

being perceived as an energy project, and (4) existing relationships/ access to decision makers.[35]

- Engineering firms as ESPs have a project focused business model. Through one project they develop familiarity with the client and then may propose more projects.[36]
- Equipment vendors as ESPs sell services bundled with their products. They have also developed business models to provide ongoing, long-term service to industrial clients in the areas of boilers, compressed air systems, and some types of motor systems.[37]
- Non-ESCO industrial ESPs address all major areas (industrial processes, cross-cutting equipment, and building). Cross-cutting equipment (e.g. compressed air systems, electric motor systems, etc.), however, is the most typical area they address.
  - US Environmental Protection Agency's (EPA's) efforts to partner ESPs with industry shows an emphasis on ESPs working in cross-cutting equipment and building areas.[38]
  - US Department of Energy (DOE) maintains a list of qualified specialists to help industrial clients find improvements and assist with DOE software tools in cross-cutting equipment areas.[39]
- Industrial process energy efficiency improvements may be identified by internal staff when an external consultant comes in to set up an industrial energy management system.[40]
- Sample US industrial ESPs include: (1) Cascade Energy, an engineering consulting firm working in cross-cutting equipment, building, and processes across a range of industrial sectors. (2) DomeTech, now a subsidiary of a large ESCO that is a subsidiary of a US manufacturer, working in buildings only. (3) Rockwell Automation, a major industrial automation manufacturer, selling variable speed drives, motors, and PLCs, across many industrial sectors. (4) Armstrong, with about 3,000 employees, an equipment vendor providing services in steam, air, and hot water.[41]
- Many energy efficiency measures achieved via ESPs may actually be done through projects pursued for other objectives, such as productivity.[42]
- Within the US, ISO50001 promises to be a major driver of industrial energy efficiency and thus of related ESP services.[43]
- Recommendations/implications of the above: Relevant engineering consulting firms and equipment vendors may be a good target for outreach and training in countries wishing to develop their industrial ESP sector. For example, there may be an opportunity to influence specialized engineering firms serving certain industrial sectors, but knowing less about energy efficiency. They might be encouraged to expand their services to

[35]Neal Elliott, 2002, op. cit.
[36]Neal Elliott, 2002, op. cit.
[37]Neal Elliott, 2002, op. cit. See also: Christopher Russell, *Outsourcing Energy Performance: Its Potential for Industrial Energy Efficiency Programs*, American Council for an Energy Efficient Economy, 2014.
[38] See categories in US EPA ISPP ("Industrial Service and Product Provider") list on the EPA website under their Industrial Energy Management Program at https://www.energystar.gov/buildings/facility-owners-and-managers/industrial-plants/industrial-service-and-product-providers ; accessed for this study in Oct. 2015
[39]See US Department of Energy listings of industrial energy efficiency specialists that can assist with DOE software and assessment in cross-cutting equipment areas (accessed for this report in Oct. 2015) at http://www.energy.gov/eere/amo/downloads/qualified-specialists-industrial-assessment-tools .
[40]Communication with Paul Sheihing, US DOE, Nov. 2015, op. cit.
[41]Companies identified via US EPA ISPP list, accessed in Oct. 2015, op. cit.
[42]Neal Elliott, 2002, op. cit.
[43]Charles Goldman et al, 2010, op. cit.

include energy efficiency. Further, a country may also wish to foster the development of ESPs that focus on certain types of cross-cutting industrial equipment (such as compressed air, motors, or boilers). There may be some demand for building energy efficiency services in industry, but a business model other than EPC may be required. While sector-specialized ESP may be desired to address industrial processes, another model is to have in-house personnel work with energy management system generalists to identify energy saving opportunities.

ESPs for SME Industrial Companies and the US IAC Program

- US SME industrial companies are less likely than large companies to retain outside help to improve energy efficiency.
- The US Industrial Assessment Center (IAC) Program, under the US Department of Energy (DOE), provides government-supported audits free to SME industrial firms. A team of 4 to 6 students led by an experienced instructor conducts one-day site visits and then prepares audit report.[44] There are "IACs" at 24 universities in the US. These are key ESPs serving the US's SME industrial sector.
- Usually, the IACs reach out to find "clients," who must have annual energy bills of USD100,000 to USD2.5 million, fewer than 500 employees, and revenues under USD100 million. Revenues of around USD20 million are most common.[45] Top types of facilities assisted include fabricated metal products manufacturing, food processing, plastic and rubber product manufacturing, and machinery manufacturing.[46]
- IAC program funding is USD6 to 7 million per year. With 600 audits are per year, per audit cost is USD10,000. Student participants in the program are sought after by employers.[47]
- Implementation rates for many types of IAC recommended measures are in the 40 to 50 percent range. Usually, factories implement themselves. Recommendations are focused on cross-cutting equipment (majority of focus) and building aspects. One-day assessments are not enough to get involved in industrial processes.[48]
- Under IAC, annual energy savings of USD5 to 8 is achieved for every USD1 of government money invested. Earlier studies suggest a five to six times return via tax revenues over time (assuming lower energy costs will increase profits and therefore taxable income each year).[49]
- Small companies may have preferred vendors or service providers for updating and repairing equipment.[50] These may be a good conduit for government efforts to promote energy efficiency.
- Sources agree that addressing process energy use in SME industrial clients is currently a largely unaddressed area in the US. Government manufacturing assistance programs advocating "lean manufacturing" may be one channel with some contributions. Other

[44]Interview with James Eggebrecht, Assistant Director, Texas A&M Industrial Assessment Center, October, 2015.
[45]Interview with James Eggebrecht, Oct., 2015, op. cit.
[46]Based on analysis of data from IAC project database, accessed in Nov. 2015.
[47]Interview with John Smegal, US Department of Energy, Oct., 2015.
[48]Interview with James Eggebrecht, Oct., 2015, op. cit.
[49] Interviews with James Eggebrecht and John Smegal, Oct., 2015, op. cit. and evaluation of IAC program in SRI International, *Saving Energy, Building Skills: Industrial Assessment Centers Impact*, 2015.
[50]Interview with James Eggebrecht, Oct., 2015, op. cit.

government programs have focused on specific SME industrial sectors with some success.

- Recommendations and implications of the above: A different strategy may be required for promoting ESPs in industrial SMEs than for promoting them in large industrial companies. Turkey may wish to consider a free or low-cost audit program for industrial SMEs. Such a program should be tested and designed to achieve a high level of audit recommendation implementation. Further, third parties (vendors or service providers) that SMEs retain for equipment repair and upgrade may be a good channel to cultivate for promoting SME energy efficiency in current equipment and in new equipment purchase decisions. An effort targeted at SME industrial processes might be incorporated into general manufacturing assistance programs via lean manufacturing principles or may be addressed through programs focusing on specific industrial sectors.

Other US Government Programs Related to Industrial ESPs

- The US EPA Energy Star Program encourages partnering between the industrial companies and ESPs. ESPs apply for the program after conducting a project with a qualifying company. The selected ESPs may use branding from the program and will appear on the EPA website. [51]
- The EPA has also contracted out development of sector specific industrial energy efficiency information, which it posts on its website.[52]
- The DOE SEP Program has an initiative for credentialing persons in energy management systems, who may then provide services to industrial participants. There are now 100 persons certified as Certified Practitioner of Energy Management Systems (CP EnMS). DOE has also developed certification for "Lead Evaluators" and "Performance Verifiers," though there are many fewer persons certified in these areas.[53]
- The SEP Program asks industrial partners to meet ISO50001 and other SEP requirements in return for free technical assistance. External consultants are hired by companies to help.[54]
- Free or cost-shared three-day assessments at large industrial facilities have been provided by DOE in the past, resulting in over 3,000 assessments in a two year period. The audits looked at several specific cross-cutting equipment systems.[55]
- In DOE's Better Factories Program, 25 percent energy reduction is targeted for industrial partners. While a lot of work is done in-house, partner companies have also worked with engineering firms and equipment vendors to achieve targets. Staff from the DOE national

[51]Information on the program and application, respectively, both on US EPA website accessed in Nov. 2015 at https://www.energystar.gov/buildings/about-us/become-energy-star-partner and at "Partnership Requirements: ENERGY STAR Partnership for Commercial & Industrial Service and Product Providers (SPP)" https://www.energystar.gov/sites/default/files/buildings/tools/Partnership%20Requirements%20ENERGY%20STAR%20Partnership%20for%20Commercial%20%26%20Industrial%20Service%20and%20Product%20Providers%20%28SPP%29.pdf .

[52] See various pages of USEPA website under the industrial energy management page, accessed for this study in Oct. 2015 at http://www.energystar.gov/buildings/facility-owners-and-managers/industrial-plants .

[53]Communication with Paul Scheihing, US DOE official, Nov. 2015, op. cit. and interview with John Smegal, US DOE official, October 2015, op. cit.

[54]Understanding of this program obtained via communications with Paul Sheihing and interview with John Smegal, Oct. 2015, both of US DoE, op. cit., as well as review of DoE materials.

[55]American Council on an Energy Efficient Economy, "Update on Save Energy Now LEADER," 2011, accessed in Nov. 2015 at https://www.ase.org/resources/doe-updates-save-energy-now-leader .

labs (including some subcontractors) provide the free technical assistance. DOE also provides free training to its industrial partners. DOE utilizes a range of trainers, usually DOE qualified specialists that are also posted on DOE's website.[56]

- US utilities are often required by regulators to achieve demand side efficiency and thus implement demand side management programs. These may result in opportunities for ESPs.
- For larger industrial companies in Turkey, government programs that promote partnerships with ESPs (such as EPA's Energy Star program) may be of interest. Turkey may also wish to further investigate USDOE's CP EnMS and other certification programs. Lastly, utility demand-side management programs may be of interest.

iii. China Case

China ESP and ESCO Market

- The China ESCO market was valued at USD12 billion in 2013 (up from 6.4 billion in 2011), substantially surpassing the US's, which was valued at USD7.6 billion that year.[57] Yet, sources from the same year and just a few years earlier present a view incongruous with these numbers. They suggest China's ESCOs have developed "only modestly" or "are marginal."[58] The USD 12 billion market size figure refers to EPC, but there may be some confusion among reporting companies as to the performance-based nature of EPC.
- China's ESCO project market in 2013 was said to be 18% of its full energy efficiency market of USD67 billion. All business conducted by "ESCOs" was USD36 billion in 2013, suggesting "EPC" was 1/3 of their business and that these "ESCOs" (if considering both EPC and non-performance based business) account for over half of the full China energy efficiency market.[59] China's low level of industrial energy efficiency and vast manufacturing sector create a huge energy efficiency market with fast payback times.[60]
- China's main ESCO contract types are shared savings, guaranteed savings, and energy management outsourcing (like ESC). In shared savings, the ESCO receives a fixed amount assuming the target is met. It does not receive more if the target is exceeded. Historically, the majority of ESCO contracts in China are shared savings, which were 66% of contracts in 2010-2011. Guaranteed savings (20%) is growing in popularity. Energy management contracts were 6%. Contracts range from 3 to 20 years, with 3 to 8 years most common. Most ESCOs have contracts of less than 5 years and payback period

[56]Content of this paragraph is based on insights gained from personal communication with Andre Defontaine, US DOE official, in Nov. 2015.
[57]Meredydd Evans et al, *White Paper: Unleashing Energy Efficiency Retrofits through Energy Performance Contracts in China and the United States*, Pacific Northwest Laboratory and Lawrence Berkeley National Laboratory, April 2015.
[58]Sources presenting views that bring the premise of a very strong Chinese ESCO market into question include: Genia Kostka (Frankfurt School) and Kyoung Shin (MIT), *Energy Service Companies in China: The Role of Social Networks and Trust*, Frankfurt School Working Paper Series, No. 168, June 2011; and Ding Ma, *Energy Service Companies (ESCOs) in China: Barriers and Drivers from ESCOs' Perspective*, Master's Thesis, Aalto University School of Business (Finland), 2013.
[59]Meredydd Evans et al, 2015, op. cit.
[60]Discussion with Donald Gilligan, Oct. 2015, op. cit.

of less than 3 years. Policy promotes shared savings over guaranteed savings, as subsidies and tax benefits apply only to the former.[61]

- Industry dominates China's "ESCO" market, which was 72% industrial, 21% building, and 7% transport (e.g. street lights) by sales volume in 2013. Share of the building sector is growing. One driver favoring the industrial sector is that industry is the only sector for which the government has set enterprise-by-enterprise targets for the largest users. ESCO projects in China are heavily skewed towards large enterprises.[62]
- Industrial "EPC" projects averaged USD2.5 million in size in 2011. From 2007 to 2009, industrial energy supply contracts (ESCs) averaged USD8.4 million, industrial guaranteed savings projects USD2.1 million, and industrial shared savings projects USD950,000.[63]
- China's industrial "ESCO" projects tend to be equipment focused. Common project types are: waste heat, waste gas, and waste pressure recovery; motor system upgrades; industrial boiler retrofits or renovations; technology upgrades in combustion systems; kiln and furnace retrofits or renovations; cooling system replacements; internal power supply renovations; and automatic control systems. "Waste heat and pressure recovery" is the most popular area, accounting for 42% of "EPC" volume from 2007 to 2009. The next most popular area, boiler and heating systems, accounted for 18%. Industrial ESCO projects in China are usually relatively specialized system upgrades and independent of each other, rather than multiple, integrated measures.[64] They are "low hanging fruit" with short payback times. Industrial ESCOs in China usually provide audits for free.[65]

China ESCOs/ ESPs

- China is said to have 5,000 ESCOs (2015). In 2011, when there were 2,339 registered, an interviewee of one source suggested there were perhaps 10 ten "real ESCOs." Another interviewee explained to the source that most Chinese ESCOs are just selling a product they manufacture rather than coming up with a complete solution for clients. Companies are motivated to register due to abundant funding for "EPC projects" and generous tax benefits.[66] Clearly, a massive amount of business is being conducted in the name of EPC and ESCOs in China, though other ESP models, such as vendor financing of equipment and installation, may account for a large portion of the market. Most of China's "shared savings" contracts do not include upside for the "ESCO" if energy savings exceed targets, though such an upside is a part of the definition of "shared savings" internationally.[67]
- In 2011, China's 2,339 registered "ESCOs" had 378,000 employees. Of the registered ESCOs, 27% had been established within the preceding five years. Registration does not require EPC experience, so these companies may be more accurately termed ESPs. In total, China had 3,900 ESPs in 2011. Large companies have substantial market share:

[61]This paragraph is based on information in China Energy Management Company Association (EMCA) for the International Finance Corporation (IFC), *China Energy Service Company Market Study*, 2013 and Meredydd Evans et al, 2015, op. cit.
[62]This paragraph is based on information in EMCA, 2013, op. cit., and Meredydd Evans et al, 2015, op. cit.
[63]This paragraph is based on information in EMCA, 2013, op. cit., and Meredydd Evans et al, 2015, op. cit.
[64]Preceding sentences in this paragraph based on information in EMCA, 2013, op. cit., and Meredydd Evans et al, 2015, op. cit.
[65]Ding Ma, 2013, op. cit.
[66] The source for these interviews is Kosta and Shin, 2011, op. cit.
[67] David Crossley of the Regulatory Assistance Project, presentation on *ESCOs in China* at ESCO Workshop sponsored by Nexant and King Mongkut's University of Technology in Thonburi, Bangkok, November, 2014; and op. cit., Merydydd Evans et al, 2015.

Less than 5% (100-plus companies) occupied 65.6% of the market in 2011.[68] The majority of Chinese ESCOs are small companies and may operate more like non-ESCO ESPs. One source indicates about 20 large ESCOs in China in 2013 while the rest are small.[69]

- In terms of origins of Chinese ESCOs, some have been transformed from energy saving equipment providers, some have been transformed from engineering and facilities companies, and some were set up as subsidiaries of large companies. A large proportion (78% in a 2012 survey) have their own patents. Some large foreign ESCOs, attracted by incentives, have entered the market. Most Chinese ESCOs are located in the Beijing, Guangzhou, or Shanghai areas. Some classify Chinese ESCOs by focus area: (1) technology oriented (equipment manufacturer – majority of market), (2) market/consulting oriented, or (3) finance oriented (leverages access to capital). Others classify them by ownership: (1) private independent, (2) subsidiary of large state-owned company, (3) subsidiary of utility (also a type of state-owned subsidiary – recently stimulated to form ESCOs due to demand side obligation requirements), and (4) subsidiary of large foreign company. The bulk of ESCOs by number fit into the first category (private independent), though the subsidiaries of larger companies, through their better networks and financial capacity, may have more success in landing projects.[70] Some researchers have found that most private ESCOs do not do well in the market, because they cannot easily establish the kind of trust needed for ESCO contracts with the main customers – large state-owned enterprises. The state-owned enterprise subsidiary ESCOs are much better at that. Private companies without deep relationships also may have a high risk of nonpayment by clients in shared savings scenarios.[71]
- Examples of specific industrial sector Chinese ESCOs include: (1) Beijing Shenwu, considered one of China's most successful ESCOs, has a core technology of "regenerative high temperature air combustion technology," which can result in 30% energy savings. It has 127 patents. Its market is companies in heavy industry. In 2013, assets were USD873 million. Shenwu is now exporting to steelmakers in other countries, given its cost advantage.[72] (2) Beijing Sinen produces technologies for treating waste in industrial boiler steam. In 2011, its product cost around USD1 million and saved about USD1.5 million in energy costs annually. Payback was around 7 to 9 months. Clients are industrial companies in petroleum, steel, and textiles that use steam regularly for production.[73] (3) Dalian East Energy Development is a private ESCO specializing in waste heat recovery. It was able to do some projects in the cement industry due to contacts of its top management, but did not have the relationships to expand its business further. (4) Hebei Fakai was set up under the Hebei Provincial Government's Demand Side Management Center. Fakai experienced a strong start due to its relationships in the government and state-owned enterprise sector and its access to capital. An early project

[68]Information in the preceding sentences of this paragraph based on EMCA, 2013, op. cit.
[69]Ding Ma, 213, op. cit.
[70]Preceding sentences of this paragraph draw on IFC, 2013, op. cit.
[71]Analysis of relationships of Chinese ESCOs and corresponding business strength based on findings of Kostka and Shin, 2011, op. cit.
[72]Details on Shenwu taken from Shenwu website at www.shenwu.com.cn accessed in Nov., 2015.
[73]Details on Sinen from Tracy Elsen, *Environmental Entrepreneurs: Beijing Sinen En-Tech Saves Water with Steam Recycling,* April 2011 accessed at World Resources Institute Blog in Nov. 2015 at http://www.wri.org/blog/2011/04/environmental-entrepreneurs-beijing-sinen-en-tech-saves-water-steam-recycling .

was a heat recovery system and steam powered electricity generation for a steel mill. (5) Baoding Runli is a private ESCO developed out of an equipment manufacturer. Focusing on its home city, where its owner and staff have good relationships, it has done well with its main ESCO business, which is recovery and recycling of residual heat from waste gas in industrial boilers.[74]

Drivers, Barriers, and Financing of Chinese ESCO/ ESP Projects

- Drivers of China's ESCO and ESP markets are: (1) government actions (see discussion on policy drivers below); (2) increased prices of energy; and (3) donor projects promoting energy efficiency and ESCOs. ESCO-relevant donor projects have been extensive in China and continue today. In particular, there have been strong donor efforts to develop financing mechanisms, including (a) a World Bank-GEF project that set up a fund to guarantee commercial bank loans to ESCOs and (b) an IFC project that worked directly with commercial banks to stimulate their loans to ESCOs and encourage use of project revenue streams instead of collateral to guarantee loans. An earlier phase of the World Bank project provided grants to support China's first three ESCOs.
- Key policies driving China's ESCO business (and its broader ESP business) are: (1) national level energy efficiency policies and programs (including targets for local officials and each of the nations' top 10,000 energy consuming companies); (2) policies for standardizing energy performance contracts and measurement and verification of savings; (3) national subsidies for shared savings ESCO projects (including USD317 million in incentive funds annually for EPC projects, with disbursement based on amount in tce of savings), national tax credits for shared savings EPC, and other tax benefits for ESCOs; (4) policies requiring utilities to implement demand side management; and (5) local government financial incentives for EPC projects and ESCOs (including subsidies for shared savings contracts that are in addition to central government subsidies).[75]
- The main barriers to the ESCO industry in China are lack of access to financing and the lack of creditworthiness and a strong credit system in China. As for the latter, it is difficult for clients to trust ESCOs; and ESCOs, in turn, are understandably worried about getting paid by clients. Lack of comprehensive M&V protocol is also a problem.[76]
- While bank loans are the most common form of third party financing for China's ESCOs, bank loans provide just 21% of the financing ESCOs bring to their projects. Indeed, many ESCOs finance their shared savings contracts with close to 100% equity. Further, less than a fifth of ESCOs appear to have had access to bank loans. Total bank loans used in 2011 by ESCOs for EPC projects amounted to 1.2 billion USD. Private, small ESCOs face the greatest challenges in getting bank loans. Having to guarantee loans with collateral rather than future project revenue streams is a key issue for ESCOs. Some banks have begun to issue loan products that allow part or all of collateral to be in the form of revenue streams of ongoing projects and the project being financed. There are some guarantee companies involved in the business; and the original World Bank-GEF

[74]Information on Dalian East Energy Development, Hebei Fakai, and Baoding Ruli based on Kostka and Shen, 2011, op. cit.

[75]Information on policies found in EMCA, 2013, op. cit.; Evans et al, 2015, op. cit.; Crossley, 2014, op. cit (on utility policies); and Ryan Schuchard and Daniel Gross, *Unlocking Energy Efficiency in China: A Guide to Partnering with Suppliers*, Business for Social Responsibility, May 2010 (on local incentives).

[76]This paragraph draws from Evans et al, 2015, op. cit. Trust issues are further covered in depth in Kostka and Shin, op. cit., 2011.

guarantee fund is still active. Further, there are some financial leasing companies (some originally ESCOs themselves) involved in the business. One insurer has recently issued a product called "energy performance guarantee insurance." This product is applied to guaranteed savings projects and can reimburse the host of the project if savings are not met, so the host can repay its bank loan. As for other forms of financing, there has been increased interest from private equity and venture capital funds in investing in ESCOs; and a few ESCOs have been publicly listed. Also, a few government and private investment funds have been set up specifically to invest in EPC projects.[77]

iv. Japan Case

Overall Japanese Market for ESPs and ESCOs

- Japan's documented ESCO market is relatively small in proportion to GDP when compared to the US and China. Performance based ESCO projects were USD370 million in 2011. Japan's ESCO market fluctuates from year to year.[78]
- All business of companies defined as ESCOs was USD497 million in 2009. The share of performance based projects was 63% in 2007 and just 34% in 2008.[79]
- Renewed Japanese Government energy efficiency efforts after the 2011 earthquake and nuclear accident did not result in much new ESCO activity.[80]
- In the early stages of Japan's ESCO market, industrial projects dominated. Japan's building sector lags the industrial sector in energy efficiency, but has gained market share, accounting for 75% of Japan's ESCOs' total business in 2008.[81]
- Shared savings contracts have overall been the most common in Japan's ESCO industry. Guaranteed savings contacts are gaining popularity. In 2011, they represented 159 of 214 total contracts. The largest average contract value that year, at 17.7 million USD, was for the contract category of energy supply and facility operation and maintenance. In comparison, EPCs that year had an average value of just USD1.7 million. Historically, the bulk of Japan's ESCO performance based work has been EPC. Over time, Japan's guaranteed savings contracts have had an average duration of about 5 years, whereas shared savings contracts have had average duration of 10 years. For ESCO projects implemented to date in Japan, the payback period generally ranges from 5 to 9 years.[82]

Japan Industrial ESP and ESCO Market

- Japan has one of the highest industrial energy efficiency levels in the world.[83] The small share of ESCOs' business in the overall economy suggest non-ESCO ESPs, especially large equipment vendors, may play a role. Internal energy mangers, mandated for the top

[77]This paragraph draws from EMC, 2013, op. cit. Information on insurance and investment funds also draws from Evans et al., 2015, op. cit.
[78]Strahil Panev et al, *ESCO Market Report for Non-European Countries 2013*, EU Joint Research Center's Institute for Energy and Transport, 2014.
[79]Hidetoshi Nakagami Ph.D., *Recent Activity of the ESCO Industry in Japan and Asian Countries*, presentation at Asia ESCO Conference 2010, New Delhi.
[80]Panev et al., 2014, op. cit.
[81]Hidetoshi Nakagami, 2010, op. cit.
[82]Panev et al., 2014, op. cit.
[83]Osamu Kimura, *Promoting Energy Efficiency in Industrial/Commercial Sector: Japanese Experience*, 2011.

consuming enterprises by the government, also play a role. At the same time, there may be few low-cost energy efficiency options left. Japanese policy requires energy intensive factories to become 1% more energy efficient per year.[84]

- Of a total of USD 227 million industrial sector ESCO business in 2007, USD65 million (29%) was non-performance based. Energy outsourcing was USD97.6 million (43%). The remainder (28%) was mostly EPC.[85]
- The most popular ESCO measure from 2002 to 2011 was cogeneration.[86] Other common types of industrial projects (based on a 2008 survey) are: pumps and fans, freezer upgrading, lighting, boiler upgrading, and industrial processes.[87]
- Payback periods for industrial projects from 2001 to 2007 averaged 8.7 years for performance contracts of all types (100 projects), and 6.9 years (53 projects) for non-performance based projects.[88]
- Clients of Japan's industrial sector ESCOs are mostly blue chip clients. SME industrial firms do not appear to be a part of the clientele.[89]

Japanese ESPs and ESCOs

- There are 20 to 30 "true" ESCOs in Japan.[90] The Japanese ESCO Association lists over 80 companies on its website. Large companies are predominant. Many are equipment providers.[91]
- The true ESCOs are all private sector companies. Most do not have energy efficiency services as their core business. Their backgrounds include: building equipment manufacturers, facility management and operation companies, consulting/engineering firms, industrial equipment manufacturers and suppliers, and companies having energy supply as their main business. The group of true ESCOs are mainly Japanese companies, as it is difficult for foreign companies to start a business in Japan.[92]
- An example of a Japanese ESCO is Hitachi ESCO. It entered the business in 1999 and eventually took it overseas to serve Hitachi Global Storage Technology Philippines, part of a Hitachi joint venture.[93] Hitachi ESCO targets customers in both the industrial and commercial sectors. Two of Hitachi ESCO's main functions are to: (1) monitor and evaluate performance of major equipment (e.g. a gas turbine, refrigeration equipment) and (2) optimize operation of complex equipment.[94]

[8484]Rob Schmitz, "Industry Leads the Way," in the California Report, Oct. 5, 2009, accessed in Nov. 2015 at http://audio.californiareport.org/archive/R910050850/a .

[85]Chiharu Murakoshi and Hidetoshi Nakagami, *Current State of ESCO Activities in Asia: ESCO industry Development Programs and Future Tasks in Asian Countries*, ECEEE 2009 Summer Study, 2009.

[86]Panev et al., 2014, op. cit.

[87]Murakoshi and Nakagami, 2009, op. cit.

[88]Nakagami, 2010, op. cit.

[89]Murakoshi and Nakagami, 2009, op. cit.

[90]Panev et al., 2014, op. cit.

[91]JAESCO, list of member companies accessed in Nov. 2015 at http://www.jaesco.or.jp/english/ .

[92]Panev et al, 2014, op. cit.

[93] Japan for Sustainability website, 2006 article, accessed in Nov. 2015 at: http://www.japanfs.org/en/news/archives/news_id026208.html .

[94]Masaaki Bannai et al, *Energy Solutions in the Industrial and Commercial Sectors*, Hitachi, 2008.

Drivers, Barriers, and Financing of Japan's ESP and ESCO Market

- Major drivers of energy efficiency efforts in Japan are energy cost and policy, including intensified efficiency efforts after the 2011 earthquake.[95]
- The Japanese Government played a critical and specific role in the launch the nation's ESCO industry. In 1996, it commissioned an investigation on the potential of ESCOs in Japan. In 1997, it organized a more in-depth feasibility study, involving 223 persons from 208 organizations. In 1998, it carried out four building sector ESCO demos. It also developed a standard contract. In 1999 to 2002, work was done on monitoring and verification, taking up the US-developed IPVMP system and adjusting it to the case of Japan. Insights for adjusting the system to the Japanese case were obtained via surveys of mainly commercial facilities.[96]
- Japan's Rational Use of Energy Act, first issued in 1979 and amended several times since has been a major driver in improving the energy efficiency of the nation's largest energy intensive industrial firms. An amendment (2008) has set mandatory targets for the sectors of steel, electricity, cement, pulp and paper, oil refining, and chemicals.[97] Industry's total energy consumption has remained flat in recent years, even though output has gone up. It was this act that required certain large industrial energy users to appoint internal energy managers and record energy utilization. Initially (in 1979), 3,000 factories were designated to comply. Examinations and a training scheme for the energy managers was launched in 1983. A streamlined process for licensing and approval of the energy managers was developed in 1984.[98] The firms closely regulated in these ways now number around 14,000 and are mainly industrial sector firms.[99] The Act has been supported by a low interest loan program for companies undertaking energy efficiency projects. It has further been supported by tax exemptions and special depreciations for SMEs purchasing energy efficient equipment.[100]
- The Japanese Government has also provided much energy efficiency information and education to industry, such as guidelines, manuals, training, and free audits for both small and large industrial companies. Three hundred to 1,000 audits are carried out annually in SMEs, while from 1999 to 2007, 40 to 100 audits per year were provided to large facilities. Most audits were provided to companies in non-energy intensive sectors, as these did not have the needed energy expertise in-house. Most of the recommendations do not require investment. They are operational improvements. Some measures requiring investment are included, but these have short payback periods (generally less than 3 years). Cost benefit analysis has shown the audit programs to be cost-effective, on a similar level to that of such programs being carried out in the US and elsewhere.[101]

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[95]Panev et al, 2014, op. cit.

[96]Information on the role of the Japanese Government in ESCO development drawn from Shirley Hansen, Pierre Langlois, and Paolo Bertoldi, *ESCOs around the World: Lessons Learned in 49 Countries*, 2009

[97]Industrial Energy Efficiency Policy Database: "JP-3: Mandatory Energy Efficiency Benchmarking in Industry," accessed in Nov. 2015 at http://iepd.iipnetwork.org/policy/mandatory-energy-efficiency-benchmarking-industry .

[98] Patrick Shiel, Nick Jeffers, Mark Dyar, *Energy Conservation Measures in Japan*, Trinity College Dublin, 2011.

[99]Kimura, 2011, op. cit.

[100]Pavev et al, 2014, op. cit.

[101]Information in this paragraph drawn from Kimura, 2011, op. cit.

- Barriers to ESCO market development in Japan include challenging economic conditions and the concern that clients may not be around long-term. Complex public procurement rules are a barrier for public sector projects. Other barriers are: Potential ESCO clients have concern that the energy efficiency measures will negatively impact their business and usually put low priority on energy efficiency. Lack of good baseline data for EPCs is a problem. Commercial banks do not have suitable knowledge of and loan products for ESCOs.[102]
- Common means of financing ESCO projects in Japan include client internal funds and financial leases by commercial banks. For some projects, Japanese ESCOs finance projects (both with their own equity and corporate debt). They also work with financial leasing companies.[103]

v. Ukraine Case

Overall Ukrainian ESP Market:

- The case of the Ukrainian ESP market is of interest as a less developed ESP market in which the industrial sector has a major need for energy efficiency services. ESCO market potential is estimated at €100 million annually.[104] Ukraine has been pursuing the "ESCO" concept, albeit mostly through non-ESCO ESPs, since it was first introduced via lectures sponsored by the US Agency for International Development (USAID) in 1996.[105]
- Ukrainian ESPs are not doing EPC or third party finance. EPC does not fit in with the existing situation of contract rights in Ukraine. Further, bank lending rates tend to be too high to make this business model profitable. Instead, the main business model is "direct services contracts."[106] As far as true (performance-based) ESCO projects are concerned, the main business model is BOOT, used for district heating. Yet, energy auditing on a fee-for-service basis is the main basic service provided by Ukrainian ESPs. Demand for audits is high in both industry and the building sector. Revenues from audits are relatively low, but they are believed to play a useful role.[107]
- Main client sectors for Ukraine's ESPs are industry and municipal heating systems.[108] Most recently, increasing attention has been put on heating, water supply, and public buildings. These have been receiving the greatest attention from the Ukrainian Government lately.[109]

ESPs in Ukrainian Industrial Sector

- In 2011, it was estimated that only 7% of industrial assets had undergone energy efficiency upgrades over the foregoing 15 years.[110] Low efficiency implies a short payback period.

[102]Barriers drawn from Pavev et al, 2014, op. cit.
[103]Means of financing drawn from Pavev et al, 2014, op. cit.
[104]Paolo Bertoldi et al, *European ESCO Market Report 2013* EU Joint Research Center's Institute for Energy and Transport, 2014.
[105]Vasily Stepanenko, *Report for ESCOs in Ukraine*, 2012.
[106]Pierre Langlois and Shirley Hansen, *World ESCO Outlook*, 2013.
[107]Stepanenko, 2012, op. cit.
[108]Langlois and Hansen, 2013, op. cit.
[109]Stepanenko, 2012, op. cit.
[110]Stepanenko, 2012, op. cit.

- The main types of energy efficiency projects implemented in Ukraine's industrial sector with the help of ESPs are: (1) improvement and reconstruction of heat supply systems, (2) reconstruction and modernization of compressed air production systems, (3) modernization of pump stations, (4) industrial process optimization, and (5) construction of cogeneration projects. Much less common are occasional projects in: (6) improvement of installation for industrial cooling and (7) waste heat recovery.[111]

Ukrainian ESPs

- Many of Ukraine's ESPs are small, energy audit-focused firms rather than true ESCOs.
- While over 120 companies are registered in Ukraine to carry out simple energy audits (many having only one person), only about 30 have the capability of carrying out full energy audits. Less than 10 companies have the capability of conducting a fuller range of activities that may be associated with a full ESCO.[112] Most of the current, active 30 ESPs are small and privately owned, though there are also among them several large companies owned either by local government or state-owned enterprises.[113]
- Ukrainian ESPs have experienced a lot of ups and downs with changing economic opportunities since the first 10 or so were set up in 1997.[114] Their history sheds light on the challenges of building an ESP sector.
- "ESCO" associations have been set up two times previously in the Ukraine and failed. The latest was set up in 2013 by 6 companies.[115]
- Since 2006, a number of Ukrainian institutions of higher learning have been training energy managers and energy auditors.[116]

Drivers and Barriers of Ukrainian ESP and ESCO Markets:

- Key drivers of Ukraine's ESP / ESCO market are: (1) low energy efficiency levels in industry and buildings; (2) high energy prices and dependence on imports for a large share of fossil fuels; (3) ISO 50001; and (4) international donor activity. (5) Government policy plays a role as both driver and a constraint: More supporting legislation is needed to enable a market with EPC.[117]
- Donors continue to be active in promoting ESPs and ESCOs in Ukraine. The most recent donor activity is focused on building and district heating ESCO projects.
- A project of the US nonprofit, the Alliance to Save Energy, has produced 14 feasibility studies for Ukrainian industrial facilities based on the outcomes of energy audits performed by Ukrainian ESPs. The purpose of the effort is to create more projects that can get financing via international standard, "bankable" feasibility studies.[118]
- Frequent changes in government have made it difficult to promote and achieve desired policy initiatives. The ESCO business model is not recognized by authorities in Ukraine. Instead, they accept only contracts for such companies to deliver goods or consulting

[111]Stepanenko, 2012, op. cit.
[112]Langlois and Hansen, 2013, op. cit.
[113]Bertoldi et al, 2014, op. cit.
[114]Stepanenko, in Stepanenko, 2012, op. cit., reviews the ups and downs of the industry.
[115]Stepanenko, 2012, op. cit. and Bertoldi et al, 2014, op. cit.
[116] Stepanenko, 2012, op. cit.
[117]Stepanenko, 2012, op. cit.
[118]Alliance to Save Energy, "Industrious Ukraine," May 29, 2008 accessed in November 2015 at https://www.ase.org/resources/industrious-ukraine .

services, rather than a full ESCO "package." There is a need for the government to develop a standard EPC contract.[119]

- Ukraine is a member of the Energy Charter Treaty (ECT). As such, it is obliged to adopt EU legislation in the field of energy savings, energy services, and energy efficiency.[120]
- Perhaps the biggest barrier for moving the Ukrainian ESP industry beyond a focus on audits is the lack of financing for energy efficiency. The commercial banks lack experience with ESCO projects and financial products specifically designed for these.
- Donor loans from international financial institutions, such as the EBRD, IFC, GEF, and World Bank, and distributed via commercial banks have been used to finance energy efficiency projects in Ukraine. One example is the Ukraine Energy Efficiency Program (UKEEP), a credit facility developed by EBRD. It provides debt financing to private SMEs for industrial energy efficiency and renewable energy projects. Only privately owned companies are eligible. Loans could be up to USD2.5 to 3.0 million each. Between 2007 and January 2013, 75 projects were approved with total loan amount of 112 million USD. Common projects financed include: rehabilitation of boilers, replacement of old gas boilers with condensing boilers, switching from electrical heating to fuel-based district heating, energy management systems or building management systems, etc.[121]

vi. Thailand Case

Overall Thai ESP and ESCO Market

- Thailand, a developing country, has been able to achieve a substantial scale ESP/ ESCO market that is predominately operating in the industrial sector.
- Thailand is estimated to have had about USD445 million in energy efficiency investments in 2012, of which investments related to ESCO projects or similar work by energy consulting firms is estimated at 100 to 200 million USD. Estimated annual market potential for ESCOs is USD500 million. Thailand's ESCO/ energy consulting market shows a growing trend, though experiences up and downs, contracting from 2008 to 2010 with the world economic crisis.[122] One source has estimated the current Thai ESCO and energy consulting market at USD150 million per year with about 300 projects per year, and thus average project size of USD500,000.[123]
- Between 2009 and 2011, 94% of total ESCO / energy consulting market contract value was in the industrial sector.[124]
- The projects in the Thai ESCO/ energy consulting market are dominated by fee-for-service arrangements rather than EPC. For contracts that are actually performance based, guaranteed savings contracts and BOOT (energy services) contracts are the main types. It

[119]Paolo Bertoldi et al, 2014, op. cit.
[120]Paolo Bertoldi et al, 2014, op. cit.
[121]Information on donor activity drawn from Paolo Bertoldi et al, 2014, op. cit.
[122]Preceding sentences in this paragraph based on Panev et al, 2014, op. cit.
[123]Verena Streitferdt and Christopher Seeley, *ESCO Market Study*, presentation at Roundtable Workshop on Financial Mechanisms to Transform the ESCO Market in Thailand: Discussion of the NAMA Proposal, June 25, 2015.
[124]Thai ESCO Information Center, Department of Alternative Energy Development and Efficiency, Department of Energy, Thailand, Presentation: *Development, Creating, and Enabling Environment for ESCO: Thailand's Experiences*, 2012.

is not common in Thailand for ESCOs to finance projects.[125] It is the larger projects that use energy performance contracting.[126]

Thai Industrial Sector ESP and ESCO Market

- Typical areas of ESP/ ESCO projects to date in the Thai industrial sector include: pumps, electric motors and inverters, CHP, lighting, and air conditioning. Energy efficiency improvement actions in industrial processes is considered an area of future promising business potential.[127]
- Small projects in the range of USD150,000 to USD1.3 million account for the majority of industrial sector ESP related projects. They are typically related to areas such as boiler and chiller replacement, heat pump installation, and energy management systems.[128]
- Large projects ranging from USD3.2 million to USD32.3 million include installation of CHP plants, waste energy recovery, and generation of energy from renewables.[129]
- Sample projects reviewed in the full report include: two cogeneration projects (one for a produce company and one for a saw mill), one air compressor project (for Yamaha), and one low pressure boiler project (for a food processing plant).

Thai ESPs/ESCO

- There are about 45 energy consulting firms/ ESCOs officially registered with the Federation of Thai Industry (FTI). Of these, about 37 were believed to be active in 2012. Only 10 conducted performance based work; and this number of firms has not changed much over the past decade. The rest of the registered firms may be more accurately described as energy consulting firms.[130] One source reports that there are also active ESPs that are not registered, perhaps 15.[131]
- The registered Thai ESPs are mainly domestic Thai companies, though one source reports 10 foreign companies among them.[132] Another source reports Japanese ESCOs tried to enter the market earlier to serve Japanese subsidiaries in Thailand, but failed. Thai ESCOs later had success with this segment of the market.[133] Many of the ESCOs/ ESPs in Thailand are manufacturers and agents/suppliers of technologies like heat pumps, variable speed drives, lighting systems, and systems for ventilation and air conditioning. A third type of ESCO/ ESP in Thailand is the energy consulting firm, generally a small company. Indeed, Thai ESCOs/ ESPs appear to come in a range of sizes from very small to quite large. Of Thailand's ESCOs/ ESPs, 25 to 50% are small companies with fewer than 50 employees. In contrast to them, the larger ESCOs usually do not have energy services as their core business. Instead, they are most often manufacturers of products.[134]
- Most Thai ESPs do not cover the full energy efficiency value chain.[135]

[125]Preceding sentences in paragraph based on Verena Streitferdt and Christopher Seeley, 2015, op. cit.
[126]Panev et al, 2014, op. cit.
[127]Panev et al, 2014, op. cit.
[128]Panev et al, 2014, op. cit.
[129]Panev et al, 2014, op. cit.
[130]Panev et al, 2014, op. cit.
[131]Thai ESCO Information Center, 2012, op. cit.
[132]Panev et al, 2014, op. cit. and Thai ESCO Information Center, 2012, op. cit.
[133]Murakoshi and Nakagami, 2009, op. cit.
[134]Information on origins and scale of Thai ESCOs/ ESPs taken from Panev et al, 2014, op. cit.
[135]Panev et al, 2014, op. cit.

- An "ESCO" association was set up under the Federation of Thai Industries (FTI) in 2012, though FTI had also played a role in promoting "ESCOs" prior to this time. An information center ("Thai ESCO Information Center") has been created by FTI with the support of the government and the association. The purpose of the center is to facilitate exchange among "ESCOs," financing institutions, and "ESCO" clients. FTI has established an annual award for the best implementers of "ESCO" projects and organizes annual trade meetings for the industry. In general, efforts to promote the industry involve FTI, the association, and the relevant government department.[136]

Drivers, Barriers, and Financing of Thai ESCO/ ESP Market

- Key drivers of Thailand's ESP market have been strong government support, the involvement of donors, energy prices, and demos. Government and donor support continue at present to play a substantial role.
- An important distinguishing feature between Thailand and some of the developing countries in which ESCOs/ ESPs have not taken off so well is the clear government support in Thailand. In 1992, Thailand enacted its Energy Conservation Promotion Act. Under the Act, the government manages a required program of efficiency for factories and buildings with peak load of 1 MW or greater. Energy audits are mandatory, as is setting a plan to reach targets. A revolving fund and tax exemptions have been developed under the Act. The revolving fund provides low interest loans for energy efficiency projects. It is funded by taxes on petroleum consumption. As for the tax exemption, energy efficiency customers (the clients of ESPs) do not pay taxes on the portion of increased profit gained from reducing energy consumption. (For large corporations, the income tax rate is 30%; and for SMEs, 15%.) Further, there is an 8 year exemption from corporate taxes for new ESCOs.[137]
- Despite the government's initial measures under the 1992 act, the ESCO/ESP business did not really get started in Thailand in a substantial way until the World Bank implemented some pilot projects, beginning in 1999. These pilot projects consisted of energy audits at industrial facilities followed by implementation of recommended energy efficiency projects. The audits were covered by donor (GEF) grants, but the energy efficiency installations were paid for by the factories themselves, though sometimes with preferential loans.[138]
- One problem in the market is lack of accepted standards and protocols for energy savings measurement and verification.[139]
- Private sector clients may have a problem in identifying qualified ESCOs / ESPs. A voluntary accreditation program for ESCOs/ ESPs is something that Thailand now lacks, but that might help with this problem.[140]
- Financing of ESP projects does not appear in Thailand to be the major roadblock that it is in some countries. The apparent reason is that in Thailand, the ESP industry has been able to convince the customers to finance the majority of projects, rather than rely on the ESCOs for financing. Yet, the difficulty of ESCOs in meeting the banks' collateral

[136]Information in this paragraph based on Panev et al, 2014, op. cit.
[137]Information in this paragraph based on Murakoshi and Nakagami, 2009, op. cit.
[138]Information in this paragraph based on Panev et al, 2014, op. cit.
[139]Panev et al, 2014, op. cit.
[140]Panev et al, 2014, op. cit.

criteria is a barrier to shared savings contracts in Thailand. Some sources suggest a guarantee fund solution be explored. The guarantee fund would be used to help guarantee loans to ESCOs for shared savings projects. There are now two government funds that can provide funding to ESCO / ESP projects, Energy Efficiency Revolving Fund, established in 2003, and ESCO Fund, established in 2008. Yet, some analysts indicate these funds have not been used as much as hoped for ESP energy efficiency projects.[141]

vii. South Korea Case

Overall South Korean ESCO Market

- With strong and ongoing government support, the South Korean ESCO market has sustained a significant level of investment for over two decades now, with the majority of investment in the industrial sector.
- Korea has had ESCOs since 1992, when the industry was launched with its first three ESCOs. The Korean ESCO industry is supported to a high degree by a program of low interest government loans. The numbers sources report for the size of Korea's ESCO market are either the amounts of low interest loans dispersed annually to ESCOs or at levels just somewhat higher. Thus, a question is whether the market is driven fully by availability of these loans or has taken off to achieve expanded market share beyond them.
- The government ESCO loans have shown fluctuation since hitting a high of USD153 million in 2005 and were USD113 million in both 2007 and 2009.[142] The stagnation of government loan amounts does not necessarily imply that the ESCO market in Korea is not growing. Yet, the lack of data in the literature on the broader market is curious and makes it difficult to confirm a growth trend, as purported in some sources.
- Data available on the number of projects in Korea's ESCO market is also associated exclusively with those projects receiving low-interest loans from the government's ESCO Fund. While total loan investment has gone up, the number of projects dropped from its high of 548 projects in 2001 to 105 projects in 2009. This reflects a shift from focus on lighting systems in buildings in the early 2000s, to more diversified (and more costly) projects encompassing improvement of industrial processes and co-generation.[143]
- While both guaranteed savings and shared savings contracts exist in Korea, some sources suggest that the vast majority of contracts, up to 98 percent, are shared savings. This figure may reflect the situation that all reported projects appear to be ones that receive preferential government loans. Those loans were set up with the intention of being used for shared savings contracts. Others suggest that guaranteed savings contracts have been gaining share, as some customers prefer them. More recently, power purchase agreement (PPA) contracts have begun to emerge in the Korean ESCO market, though these are still few in number.[144]

[141]Information in this paragraph based on Panev et al, 2014, op. cit.
[142]Su-Young Huh, *ESCO System in Korea*, presentation at Asian ESCO Conference in Delhi, January, 2010.
[143]Su-Young Huh, 2010, op. cit.
[144]Pierre Langlois and Shirley Hansen, 2013, op. cit.

South Korean Industrial Sector ESCO Market

- From 1993 to 2008, process improvement, cogeneration, and waste heat recovery were the top three ESCO project types in South Korea in terms of loan amounts disbursed. In terms of more specific project types, examples of process improvement projects include: (1) naphtha cracking heater coil replacement and (2) ejector type replacement (replacing steam by EG type). Examples of waste heat recovery systems include: (1) waste heat recovery boiler, (2) mechanical (thermal) vapor re-compressor, and (3) heat exchanger for heating and cooling.[145]

South Korea's ESCOs

- There were 227 registered ESCOs in South Korea in 2012, an extremely large rise from 2009, when there were 126.[146] One source indicates that of 126 registered ESCOs in 2009, only about 30 to 40 were active. Apparently, about 30 ESCOs typically register each year and about 30 lose (or cancel) registration each year.[147] Competition is intense and a number of ESCOs fail each year.[148]
- The market has a mix of the largest multi-national ESCOs and smaller, local counterparts.[149] One source suggests most ESCOs in Korea are small and medium sized businesses and thus have problems obtaining financing for shared savings projects.[150]
- KAESCO, the Korean Association of ESCOs, serves as facilitator of the industry at both the national and local levels.[151]

Drivers and Financing of South Korean ESCO Market

- National government policy and programs, particularly the ESCO low interest loan program, are key drivers of the Korean ESCO industry. Government's actions, in turn, are driven by Korea's heavy dependence on fossil fuel imports. Industry also responds to energy costs by increasing its interest in energy efficiency opportunities.[152]
- The South Korean Government has promoted the ESCO sector in multiple ways, some direct and some indirect. On the indirect level, they promote energy efficiency in potential industrial ESCO clients through a five-year voluntary agreement program, with financial and technical support, as well as tax incentives. Further, since 2007, large energy consuming entities (over 2 ktoe/year) have been required to carry out mandatory energy audits every five years. Industries that invest in CHP for their own heat supply can receive tax reductions. Further, factories consuming over 20 ktoe (or over 10 ktoe for those in the automobile, food, and electrical and electronics industries) can participate in the Government's Energy Savings Partnership Program (ESP), whose focus is sharing energy saving technologies specific to certain industries. In 2013, ABB reported that 195

[145]Su-Young Huh, 2010, op. cit.
[146]Panev et al, 2014, op. cit.
[147]Su-Young Huh, 2010, op. cit.
[148] Pierre Langlois and Shirley Hansen, 2013, op. cit.
[149]Pierre Langlois and Shirley Hansen, 2013, op. cit.
[150]J.S. Shin, I.H. Ahn and Suduk Kim, *ESCO Business in Korean Energy Market: The Current Issues and Possible Solutions*, presentation in April, 2005.
[151]Panev et al, 2014, op. cit.
[152]Pierre Langlois and Shirley Hansen, 2013, op. cit.

companies were involved in this program, which led to substantial savings in both fuel and electricity.[153]

- On the direct level, the South Korean Government has developed a legal framework to support ESCOs, institutions that finance ESCO projects, and the clients of ESCOs. It also has preferential financing and tax programs to promote ESCOs.[154] Following the establishment of the first four ESCOs in 1992, the Government set up its ESCO Fund, which is meant to support the shared savings projects of small and medium sized ESCOs. In 2004, it introduced the guaranteed savings contract model to the country. And, in 2006, an ESCO accreditation program was developed.[155]
- Korea's energy conservation fund was established in 2008 and is managed and operated by the Korea Energy Management Corporation ("KEMCO"). The fund is known as the "Rational Use of Energy Fund." The ESCO Fund is now a component of this overall fund. Of the USD427 million total loan amount in 2010, aside from the USD113 million going to ESCOs, other categories receiving loans were: (1) installation of energy saving facilities (USD172 million), (2) voluntary agreements (USD117 million), and (3) integrated energy supply (25 million). Presumably, some of these other areas might stimulate ESCO or ESP activities, though the loans will go directly to the client entities instead of the ESCOs. The repayment period for loans is four to ten years.[156] Aside from this Government loan fund, small and medium sized ESCOs may have trouble receiving commercial bank loans for shared savings type projects due to their limited amount of collateral.[157] Indeed, aside from the Government fund, there was not much evidence in the literature for other types of programs to stimulate commercial bank lending to ESCO projects.

viii. Germany Case

Overall German ESP and ESCO Market

- Germany is considered one of the leading European ESCO markets, in terms of both market scale and maturity. The majority of its ESCO market consists of its energy supply contract (ESC) market, while the EPC market is relatively small.
- In 2013, German ESCO market value was €3.5 to 5 billion, of which 80 to 85% was ESCs and 8 to 9% EPCs. Total potential ESCO market is estimated at €20 to 30 billion, the large scale of which is likely due to untapped ESCs, which also include fuel costs.[158]
- German non-ESCO ESP segment market size in 2011 has been estimated as: (1) €265 to 467 million for advising and audits and (2) €250 to 500 million for energy management systems. While this non-ESCO segment is smaller than the ESCO segment (€3 billion in

[153]ABB, *South Korea Energy Efficiency Report*, 2013.
[154]Pierre Langlois and Shirley Hansen, 2013, op. cit.
[155]Su-Young Huh, 2010, op. cit.
[156]Su-Young Huh, 2010, op. cit.
[157]J.S. Shin, et al, 2015, op. cit.
[158]Bertoldi et al, 2014, op. cit.

2011), the ESCO market estimate includes equipment (and in the case of ESCs, fuels), whereas the non-ESCO segment estimates do not.[159]

- For both ESC and EPC in Germany, it is mainly ESCOs that handle the financing (i.e. shared savings in the case of EPC). The average size of energy supply contracts is €20,000 per year. The average energy baseline addressed by German EPCs is over €150,000. Typical annual energy savings for ESCs is 15 to 20%, while for EPCs it's 20 to 25%.[160]
- The majority of the German ESCO market is focused on buildings. Market breakdown in 2012 was 60% residential, 15% institutional, and 20% industrial and commercial combined. Yet, industrial and commercial markets are said to be growing. ESCs mainly serve the residential sector, though industrial and commercial projects are growing.[161] EPCs are mainly focused on the public sector, with some activities in the service sector, such as hotels.[162] It appears there is little EPC in the industrial sector. Thus, it is likely that aside from ESCs, the main ESP involvement in German industry, as in the US, is via non-ESCO scenarios, such as service provided by engineering vendors and installers. Internal capabilities for energy efficiency likely play a role as well.
- Reflecting the predominance of ESC, the most common German ESCO projects are in heating and hot water supply, renewables, and CHP. In addition, public lighting, control and automation, and pumps are frequently upgraded. Projects in the areas of industrial processes, industrial cooling, motors, inverters, indoor lighting, and air conditioning and ventilation are less common, as are insulation in building shell and whole building refurbishment.[163] Most work is said to be limited to boiler rooms; and the majority of projects run on natural gas.[164]

German Industrial Sector ESCO and ESP Market

- While penetration of the industrial sector ESCO (and ESP) market may be weak, sources suggest strong potential and the need for ESPs to take a more "niche" or specialized approach to this sector as compared to the building sector. ESCOs need to go beyond a focus on supply of energy and heat and supply things like cold and compressed air to industrial processes.[165]
- It is estimated that only 10 to 15 companies in Germany are active in EPC for the industrial sector. Further, none of them is solely focused on that sector.[166]
- Strong market potential (of €100M or more) has been suggested in Germany for EPC in each of a number of industrial sectors, including autos and machinery, plastics and rubber, and chemicals and pharmaceuticals. Annual market potential of over €50M has been indicated for each of: food and beverages; glass, ceramic, and non-metallic mineral processing; and metals and steel. In addition to skills in cross-cutting areas like

[159]For 2011 market size, Jan W. Bleyl and Friedrich Seefeldt, *World ESCO Outlook: Germany*, 2012; for other market sizes, Offermann et al, 2013, op. cit.
[160]Bertoldi et al, 2014, op. cit.
[161]Bleyl and Seefeldt, 2012, op. cit.
[162]Bertoldi et al, 2014, op. cit.
[163]Bertoldi et al, 2014, op. cit.
[164]Bleyl and Seefeldt, 2012, op. cit.
[165] Maike Bunse and Wolfgang Irrek, *National Report on the Energy Efficiency Services Business in Germany*, Wuppertal Institute, 2010.
[166]Bunse and Irrek, 2010, op. cit.

compressed air, lighting, pumps, and motors, ESPs will need sector-specific skills to address these industries.[167]

- ESCO services provided to SME industrial facilities at present are heating services. There is a market need to provide ESP services to industrial SMEs in cross-cutting technologies, such as the provision of light, compressed air, and ventilation, and the production of cold.[168]

German ESCOs and non-ESCO ESPs

- There were 500 to 550 companies classified as ESCOs in the German market in 2013.[169]
- There were an estimated 12,500 to 14,000 ESPs providing advice and audits in 2011.[170]
- A complete estimate for energy management system providers was not found. Data indicates that there were 776 companies certified in ISO50001 in Germany in 2011 and about 70 companies with energy management software products that year.[171]
- A range of types of companies provide energy efficiency services in Germany, including "pure" ESCOs, energy companies, engineering companies, consultants, and energy efficiency equipment providers. In last group, it is the providers of building equipment and measurement and control systems that are most active in the ESCO market.[172] Others involved include craftsmen, planners, and architects.[173]
- Small companies do not play a large role in the German ESCO market, though they may in other ESP areas, such as advice and audit provision. Within the ESCO market, ESC providers are mainly building equipment and control manufacturers, engineering firms, facility management and operation companies, and energy companies. Most are international firms, though more local firms have entered the market recently due to increased interest by customers. Smaller ESCOs face challenges due to the legal environment and competition. EPC providers in Germany are also mainly large international companies or their subsidiaries. The EPC providers also include project developers, financial organizations, and craftsmen. There are no public ESCOs in Germany.[174]
- Of the 500 to 550 ESCOs in Germany, many do not have energy ESC or EPC as their main area of business.[175]
- Market facilitators (agencies and associations) play a critical role in the German market in providing communications, networking, and advice in support of ESCOs and ESCO projects. There are several relevant associations active in the ESCO and/ or non-ESCO ESP areas.[176]

[167]Bunse and Irrek, 2010, op. cit.
[168]Bunse and Irrek, 2010, op. cit.
[169]Offerman et al, 2013, op. cit.
[170]Offerman et al, 2013, op. cit.
[171]Offerman et al, 2013, op. cit.
[172]Offerman et al, 2013, op. cit.
[173]Bertoldi et al, 2014, op. cit.
[174]Bertoldi et al, 2014, op. cit.
[175]Bertoldi et al, 2014, op. cit.
[176]Bertoldi et al, 2014, op. cit. and Bunse and Irrek, 2010, op. cit.

Drivers, Barriers, and Financing of the German ESP and ESCO Markets

- Main drivers of the German ESP and ESCO markets are energy costs and EU and national policy. The development of smart technologies for buildings is also leading to market expansion. Clients' lack of capital and the role of facilitators also help to drive the market.[177]
- Despite an advanced legislative framework, there may still be unclear or inconsistent areas: Germany's Renewable Energy Act disadvantages ESC as compared to owner operated heating installations, in that ESCO has to pay for renewable energy assessment while owner-operator does not.[178] Recently proposed changes in the Energy Tax Law could also result in unequal treatment for energy investments made by ESCOs as compared to those made by the hosts themselves.[179]
- Competition in the German ESCO sector is high, especially because some utility ESCOs do not have profit as their main motive.[180]
- German banks are quite familiar with ESCO projects, a positive situation as compared to many other countries.[181]
- A German program provides subsidies for energy audits in SMEs (both manufacturing and non-manufacturing). Launched in 2008, the program subsidizes initial (screening) audits, which last two days, with an up to 80% subsidy. It subsidizes comprehensive audits, which last up to ten days, with an up to 60% subsidy. The program is managed by KfW. Names of consultants that provide audits and have registered with KfW are provided online. Between 2008 and 2010, there were 10,400 applications approved for such audits. An average of 2.8 out of an average of 5.3 measures recommended per audit were implemented by the SMEs. From 2008 to 2010, companies paid an average of €900 for the initial audit and received €1,200 subsidy. For the detailed audits, they paid on average €2,000 and received €4,000 subsidy. This suggests average total cost per audit of €2,100 for the short audits and €6,000 for the long ones.[182] Government financial support may also be available to SMEs for implementation of audit recommendations if 20% energy savings can be achieved.[183]
- While there are some financial incentives in areas such as building refurbishment and energy audits, many German ESCO projects and other energy efficiency initiatives are carried out without such incentives. The shared savings model tends to be preferred in Germany, so that the client does not have to provide the upfront costs.[184]

[177]Bertoldi et al, 2014, op. cit.
[178]Bertoldi et al, 2014, op. cit.
[179]Bunse and Irrek, 2010, op. cit.
[180]Bertoldi et al, 2014, op. cit.
[181]Bertoldi et al, 2014, op. cit.
[182]Edelgard Gruber et al, *Efficiency of an Energy Audit Program for SMEs in Germany – Results of an Evaluation Study*, ECEEE Summer Study, 2011.
[183]Barbara Schlomann and Wolfgang Eichhammer et al, *Energy Efficiency Policies and Measures in Germany*, Fraunhofer Institute, November, 2012.
[184]Bertoldi et al, 2014, op. cit.

ix. Italy Case

Overall Italian ESP and ESCO Market

- Italy's ESCO market is considered to be one of the more developed ones in Europe, because of the large group of companies involved and relatively large volume of business. Yet, the definition of ESCO has led to confusion about which companies are really ESCOs.[185]
- Estimated Italian ESCO market size was €500 million in 2011. Estimates of full ESCO market potential are €1 to 10B per year.[186] The full ESP market was estimated at €1.83 billion in 2009, with €532 million attributed to companies with energy efficiency as a core business.[187]
- The estimated number of active ESCO contracts in Italy in 2013 was in the hundreds. The largest proportion of the Italian ESCO market is served by energy supply contracts (ESCs), whereas EPCs are less common. ESCOs tend to provide a package of services in their ESCs, combining traditional energy supply with energy management and energy efficiency improvements. EPCs that do exist are used for smaller projects in areas such as cogeneration, heating management, and efficient lighting. In the EPC category, both guaranteed savings and shared savings contracts are used. Other types of contracts include facility management contracts and BOOT contracts, which are relatively common.[188]
- Italy's ESCOs focus on the largest and most profitable projects, with public sector projects, especially in healthcare being most common. Energy efficiency opportunities in Italy's vast SME sector and in households remain largely untapped. Energy efficiency work by ESPs in industry (which consists mostly of SMEs) is growing, though is still constrained by financing. The SME sector is considered one of untapped potential for ESPs, with little competition. As tailored solutions will be required, small ESPs may be the best fit.[189]
- The most typical technologies and applications used by Italian ESCOs, based on their responses to a 2011 survey of their activities from 2005 to 2011, are: energy production and CHP (35% of ESCOs), renewables (34%), lighting (30%), climatization (18%), energy management (15%), electric motors and inverters (14%), district heating (14%), insulation measures (9%), and energy efficient refrigeration (8%).[190]
- Some industrial sectors have been more deeply pursued by ESPs than others. For example, cogeneration is widespread in Italy's paper industry. Yet, in areas like the food sector and the textiles sector, there is much room for energy efficiency improvements.[191]
- The part of the industrial sector that has been penetrated is served by the small, private ESCOs and non-ESCO ESPs. The main services they provide in the industrial sector are energy audit, project design, plant and equipment installation, and verification of results.

[185]Bertoldi et al, 2014, op. cit.
[186]Bertoldi et al, 2014, op. cit.
[187] Nathalie Sabbatucci and Nicola Labanca, *National Report on the Energy Efficiency Service Business in Italy*, 2009.
[188]Bertoldi et al, 2014, op. cit.
[189]Sabbatucci and Labanca, 2009, op. cit.
[190]Bertoldi et al, 2014, op. cit.
[191]Bertoldi et al, 2014, op. cit.

The financing of industrial ESCO and non-ESCO ESP projects comes from client self-funding and bank loans.[192]

Italian ESCOs and ESPs

- Italy had between 100 and 150 ESCOs in 2009.
- The Italian Regulatory Authority for Electricity and Gas has a registry of "Energy Services Enterprises," in which 2,000 to 3,000 companies are registered. The purpose of the registry is that the companies listed have access to the nation's white certificate mechanism. Yet, only a small proportion (387 companies) had obtained such a certificate by 2013. Further, while many of these companies describe themselves as ESCOs, experts indicate that far fewer have actually undertaken ESCO projects. In 2010, Italy created a standard for ESCOs to overcome this confusion. Forty-nine companies were registered under this standard as of 2013.[193]
- There is a divide in the Italian ESP market between (1) the very large ESCOs serving large public projects and counting the ESCO business as only a small part of their overall business and (2) the small ESCOs and non-ESCO ESPs focused fully on the energy efficiency business and on smaller projects. The true ESCO business is dominated by a few large ESCOs, which are mainly subsidiaries of large corporations. Italy's legislative framework related to ESCOs is said to favor the large players.[194]
- The large companies involved in Italy's ESCO market consist of: multi-utility companies, energy distributors, retail energy sale companies, and consulting firms. The business of these large providers is rarely focused on energy efficiency alone. Due to their financial capabilities and connections, they are able to pursue very large projects in the public sector and win public tenders. The small ESPs, in contrast, have energy efficiency as their core business. Their areas of focus include efficient electricity production, lighting services, and electrical drive efficiency, which tend to be associated with private sector opportunities, particularly those in industry and the commercial sector. For these smaller companies, customization of their product to their clients is important in marketing. Further, the initial audit is a critical juncture through which to secure future business.[195]
- There are two major ESCO associations in Italy and a couple of other relevant associations.[196]

Drivers, barriers, and financing of the Italian ESCO and non-ESCO ESP Markets

- The main drivers of the ESCO and non-ESCO ESP markets in Italy are growing demand side interest in energy efficiency and Italy's legal framework and relevant certifications (particularly the white certificate mechanism). In addition, credit lines and other financial mechanisms promote the market, as does active promotion and awareness raising.[197]
- There is criticism that ESCO related policy in Italy favors the larger players. It has been suggested that ESCO and contract definitions in the legislative framework need to address a wider range of types of companies, so that smaller companies can successfully be

[192]Sabbatucci and Labanca, 2009, op. cit.
[193]Bertoldi et al, 2014, op. cit.
[194]Bertoldi et al, 2014, op. cit.
[195]Sabbatucci and Labanca, 2009, op. cit.
[196] Bertoldi et al, 2014, op. cit.
[197]Bertoldi et al, 2014, op. cit.

involved. There is also a need to improve the legal basis for verification and performance guarantees.[198]

- The white certificate mechanism is related to projects qualifying under government requirements for a number of gas and electricity suppliers to achieve a certain level of energy savings annually. Certificates obtained for implementing energy efficiency projects may be sold to the suppliers so that they may meet their targets.[199]
- Italy has a specific regulation for ESCO performance based contracting. Standards for ESCOs were issued in 2010 and are expected to increase credibility in the market. The standards were being revised in 2013. Minimum certifications for ESCOs require capabilities in EPC contractual agreements and energy management systems.[200]
- Difficulties in financing ESCO projects are considered a barrier to the ESCO industry's development in Italy, particularly for small ESCOs. Banks tend to lack the interest and expertise to finance ESCO projects. They require collateral for loans and will not allow guarantee based on projected EPC revenue streams. ESCO projects, in the end, are financed by a range of sources, especially ESCO equity and commercial bank loans. ESCO equity is important in heat service contracts and thus likely one of the key reasons that large companies dominate large projects in this area.[201]
- Tax credits for energy efficiency and thus ESCO projects exist (a 65% tax credit for building refurbishment and 20% for new efficient engines and inverters in the industrial sector), but there are contradictions that need to be resolved. In particular, energy services are subject to 20% VAT, while simple equipment purchase has 10% VAT.[202]
- The white certificate mechanism is a positive force for the ESCO industry in Italy as it allows project owners to gain extra profits via selling their achieved energy savings. Compared to other white certificate schemes in Europe, the Italian one has been indicated to be the only one to include in its design specifics to support the business of ESCOs. It allows the ESCOs themselves to receive the white certificates, the selling of which can then serve as an additional source of income for them. Yet, so far the white certificates obtained by ESCOs have been for project types that would have easily occurred without the certificates.[203]

x. United Kingdom Case

Overall UK ESCO Market

- Like a number of other ESCO markets in Europe, the UK market began with energy supply services, usually hot water and steam. This business first began in the 1960s when a company took over management of boiler houses for clients.[204] The oil company Shell entered the business in 1984, but added upgrading of the heating plant, fuel switching

[198]Bertoldi et al, 2014, op. cit.
[199]Bertoldi et al, 2014, op. cit.
[200]Bertoldi et al, 2014, op. cit.
[201]Bertoldi et al, 2014, op. cit.
[202]Bertoldi et al, 2014, op. cit.
[203]Sabbatucci and Labanca, 2009, op. cit.
[204]Bertoldi et al, 2014, op. cit.

(often coal to gas), and guaranteed cost savings on energy bill. British Petroleum soon followed.[205]

- No available estimates of annual UK ESCO or ESP market volume were identified. Experts suggest annual market potential for ESCOs is about €1 billion for the non-residential sector.[206]
- ESC (energy supply contracts) and EPC are both common in the UK market, but ESCs in the form of traditional UK-style heat contracts, dominate. In the EPC segment, which is growing, both shared savings and guaranteed savings occur. BOOT contracts also occur in the market.[207]
- The most advanced sectors of the UK ESCO market are public buildings, education, and healthcare facilities. Commercial buildings are also considered an active market segment.[208] The industrial sector also appears to be a profitable one for UK ESCOs.[209]
- Areas that are popular for UK ESCO projects due to their profitability include HVAC, public lighting, and energy conversion and supply technologies, including district heating and cooling. Recent price decreases in equipment contribute to profitability of such measures. Indoor lighting with LEDs is also popular, as large savings that is easy to guarantee is possible. External wall insulation is still considered too expensive to be profitable for UK ESCOs.[210]

UK Industrial Sector ESCO Market

- The UK industrial ESCO sector opportunity range may be broken down into: (1) supply of reliable and cost competitive heat, power, and compressed air; (2) space heating and hot water demand for the building envelope (building applications); and (3) industrial processes. As of 2009, analysts found UK ESCOs had been successfully addressing the first two areas, but had not gotten involved in industrial processes, due to complexity.[211]

UK ESCOs

- An estimated 30 to 50 ESCOs are active in the UK market.[212] One source indicates 11 main ESCOs and then a number of smaller companies (some ESCOs and some non-ESCO ESPs) serving smaller clients, such as single commercial premises, private homes, etc. The smaller ESCO or non-ESCO ESP companies are usually set up by consultants. In the case of those doing true ESCO projects, they have in some way acquired a means of financing. The smaller companies do not always provide the full range of ESCO services, such as guarantees and operations and maintenance. Interestingly, some operations and maintenance companies have seen opportunity in the market and extended their services to include ESCO projects. Some consolidation has been noted in the UK ESCO industry, with smaller companies being taken over by larger ones.[213]

[205]Hansen et al, 2009, op. cit.
[206]Bertoldi et al, 2014, op. cit.
[207]Bertoldi et al, 2014, op. cit.
[208]Bertoldi et al, 2014, op. cit.
[209]Hansen et al, 2009, op. cit.
[210]Bertoldi et al, 2014, op. cit.
[211]Hansen et al, 2009, op. cit.
[212]Bertoldi et al, 2014, op. cit.
[213]Langlois and Hansen, 2013, op. cit.

- The main players in the UK's ESCO market have continued to be large international manufacturers of building automation and control systems, as well as energy service and supply contractors. Facility management companies are also fairly strong in the market. In addition, a number of construction and property companies have entered the UK ESCO market. A recent phenomenon is the entry of utility companies into the UK ESCO market, looking to provide their customers with more services.[214]
- Some of the various trade associations in the UK have ESCO arms or ESCO interests. The most notable are the Energy Services and Technology Association (ESTA), which has a "Contract Energy Management" subgroup of 14 members, and the Energy Managers Association (EMA).[215]

Drivers and Financing of UK ESCO Projects

- The drivers in the UK market are mainly market demand for energy efficiency due to both environment and cost motivations. For some companies, public image is a motivation. Policy drivers includes both legal requirements to reduce energy use and financial incentives for those that do so.[216]
- Compared to many other countries, the UK Government has provided much less in the way of specific legislative or financial support for promoting the ESCO industry. The attitude has been relatively *laissez faire*, assuming the market will do this job. At the same time, there have been more recent pushes for the public sector to utilize ESCOs, in part so that private funds rather than funds from public budgets can be used to provide the up-front financing.[217]
- Specific regulations on ESCOs, such as standard contracts, do not exist in the UK. Some suggest this has the benefit of creating more fluidity in the market for various types of contracts and projects, which serve as market experimentation of sorts. At the same time, the UK's very strong climate and energy conservation policy, including stringent targets, serves as a positive driver to its ESCO industry. Associated measures, including financing incentives (e.g. feed-in tariffs and the renewable heat incentive), capital grant programs (e.g. a fund for local energy assessments), finance programs, and low-carbon obligations (such as low-carbon building regulations), can all benefit ESCOs.[218]
- UK ESCOs tend to have access to a source of capital for financing. Most projects are financed either via ESCOs' own funds or via private sector lenders.[219] There has been some improvement in commercial financing in the UK of ESCO projects, as the banks become more familiar with such projects and see them as less risky. At the same time, as in other countries, there is a still a problem that the cash flow of the EPC cannot be used as a guarantee for the loan, so that collateral is required instead.[220]

[214]Bertoldi et al, 2014, op. cit.
[215]Bertoldi et al, 2014, op. cit.
[216]Bertoldi et al, 2014, op. cit.
[217]Shirley Hansen et al, 2009, op. cit.
[218]Bertoldi et al, 2014, op. cit.
[219]Shirley Hansen et al, 2009, op. cit.
[220]Bertoldi et al, 2014, op. cit.

xi. EU Energy Service Provider Related Policy and Programs

Introduction and Early Efforts

- The European Union plays a major role in energy efficiency policy throughout Europe. This has an impact on the role of ESPs, including ESCOs.
- Since an initial initiative in 1988, the European Commission has continued to promote the ESP, and more specifically the ESCO, industry via legislation, programs, and financial mechanisms.
- The Commission issued two standard types of ESCO contracts, one for buildings and one for industry, in 1996, specifically prepared by national lawyers for each member state according to their legal requirement. A number of other measures were adopted in ensuing years as well. These EU measures for promoting ESPs and energy efficiency projects work in conjunction with country-specific measures that are adopted by individual member countries.

EU Energy Service Provider Related Policy

- At the center of European legislation relevant to the ESPs is the *Energy Efficiency Directive* (2012/27/EU). This Directive was proposed in June 2011 and entered into force in December 2012. Member states were required to meet a deadline of June 5, 2014 in their passing of appropriate implementation measures.
- The key ESP-related requirements for member states of the *Energy Efficiency Directive* are specified in Article 18.[221] These include: (1) disseminating information on energy services contracts and on the clauses that should be included in them; (2) providing a list of qualified or certified energy service providers (ESPs); (3) promoting energy service provider projects in the public sector; (4) providing a qualitative review in the member state's National Energy Efficiency Action Plan on the current and future development of the energy services market; (5) taking measures, as needed, to remove regulatory and non-regulatory barriers to EPC and other energy efficiency services business models; (6) enabling market intermediaries to promote the energy services industries; and (7) ensuring that energy distributors, distribution system operators, and retail energy sale companies do not take actions to impede the demand and delivery of energy services.
- Other aspects of the *Energy Efficiency Directive* that may serve as drivers of the ESP market include: (a) Article 7, which is entitled "Energy Efficiency Obligation Schemes," mandates that member states adopt energy efficiency obligations for certain energy companies.[222] It requires that member states "permit obligated parties to count towards their obligation certified energy savings achieved by energy service providers or other third parties." (b) Article 5, entitled "Exemplary Use of Public Buildings," requires the renovation of 3% per year of total floor space of heated and/or cooled buildings owned by the member state's national government. The Article explicitly recommends energy management systems, energy audits, and the use of ESPs. (c) Article 8 requires states to "promote the availability to all final customers of high quality energy audits which are cost-effective." And, it requires states to "develop programs to encourage SMEs to

[221]Bertoldi et al, 2014, op. cit.
[222]Bertoldi et al, 2014, op. cit.

undergo energy audits and the subsequent implementation of the recommendations from these audits."

- The *Energy Performance of Buildings Directive (2010/31/EU)* is the main EU legislation for reducing energy use in buildings. The general requirement of the Directive should promote opportunities for ESPs. Article 11 of the Directive calls for the establishment of Energy Performance Certificates for Buildings, which are known to promote opportunities for ESCOs.[223]
- European standard *EN 15900:2010* is a standard for energy efficiency services. It is meant to serve as a reference document on "appropriate qualification, accreditation and/or certification schemes for providers of energy efficiency services." The standard is also meant to "provide guidance to both customers and providers of energy efficiency services… and to contribute to the development of a market for energy efficiency services."

EU Programs Related to ESPs

- Recent and current EU programs related to ESPs include: (1) EU Energy Performance Contracting Campaign (EPCC), which aims to increase use of EPC via dialogue, training, and guidance documents; (2) Covenant of Mayors, which calls for local authorities to voluntarily commit to a 20% percent reduction in carbon dioxide emissions by 2020, with ESCOs as one key means of achieving this; and (3) Intelligent Energy Europe (IEE), which has funded a large number of projects promoting ESPs including the European Energy Service Initiative and has now been replaced by Horizon 2020, the PERMANENT Project, EESI2020, and Transparense.[224]

EU Funding Sources for ESP Projects

- EU funding sources that may be relevant to ESP Projects include: (1) The Multi-Annual Financial Framework: includes "Structural and Cohesion Funds" that have been used for energy efficiency and ESCO investments in a number of countries. (2) Project Development Assistance (PDA) structures of Intelligent Energy Europe: meant to support local government agencies in developing bankable sustainable energy projects. A number of funding sources are involved: EIB-ELENA, MLEI-PDA, EBRD-ELENA, CEB-ELENA, and KfW-ELENA. (3) EEE-F (European Energy Efficiency Fund): can be used for both project development and investments, including loans, guarantees, or equity participation for projects conducted in the public sector, including ESCO projects. It's managed by Deutsche Bank. (4) European Investment Bank: has been providing guarantees for ESCO projects and has launched "JESSICA" to support urban development projects with either equity, debt, or guarantee investment.[225]

[223]Bertoldi et al, 2014, op. cit.
[224] Bertoldi et al, 2014, op. cit.
[225] Bertoldi et al, 2014, op. cit.

xii. Recommendations Emerging from International Experience with ESPs in Industrial Energy Efficiency

- Take a broad approach to development of energy service providers for industry, encompassing both fee-for-service and performance based models. Do not overemphasize the ESCO model at the expense of ignoring the development of other ESP company types that may be a better fit for the industrial sector: Findings in other countries suggest it would be unwise to invest the majority of available resources into promoting performance based contract models for energy service providers in the industrial sector. At the same time, experience in Western countries suggests ESCOs and their performance based contracts may have a role to play in two areas within the industrial sectors: energy supply contracting (such as CHP) and building retrofitting. Experience in Asia suggests ESCOs may have a broader role to play in industrial energy efficiency. In China, in particular, this may include provision of key energy consuming equipment for industrial processes.

- In developing a strategy for fostering ESPs to serve the industrial sector, break down the needs of industries into the following categories and develop activities for fostering ESPs in each category: (1) cross-cutting equipment – requires ESPs with expertise in various areas such as air compressors, boiler systems, motor systems, fans, mixers, etc.; (2) industrial processes – may require ESPs with expertise in specific industrial sectors; (3) energy management systems – ESPs can be generalists, but should be talented at working with internal staff to identify energy saving actions. Candidates for each area may then be identified and targeted for outreach and training. Based on findings, the most active area for industrial ESPs in developed countries appears to be the first category – ESPs specialized in various types of cross-cutting industrial equipment. Thus, this may be the best area on which to focus initially.

- In fostering ESPs, consider the additional strategy of outreach and training for those companies that are already providing services to industrial customers. For large manufacturers, these will be engineering companies and equipment vendors. For small manufacturers, these providers may be companies the SMEs trust to help them with equipment repair and replacement. Many of these companies (both those serving large industry and those serving small industry) may not have expertise in energy efficiency at present, but may be receptive to expanding their capabilities in that area.

- In light of the incredibly rapid growth of "ESCOs" in China's industrial sector, consider the China model of promoting homegrown manufacturers of energy-saving equipment. This may not be a true or traditional ESCO model. Yet, it shows that, with strong subsidies and tax benefits, projects incorporating domestically developed energy saving equipment in the industrial sector can lead to very rapid growth of the "ESCO" sector. To understand whether the China model may apply in Turkey, an assessment of Turkey's level of industrial energy efficiency "low hanging fruit" may be necessary. (The success of the "China model" is believed to be tied to the low level of industrial energy efficiency in the nation.) It is also important to note, however, that China's ESCOs have focused on large industrial companies as their market. Finally, one approach to consider is

cooperation between stand-out Chinese ESCOs and Turkish counterparts in the Turkish market.

- Consider a program of free or partially subsidized industrial energy audits, particularly for SME industrial enterprises. Ensure that detailed guidelines are available for audits and that audit quality is monitored. Such programs in the US, Germany, and Japan have achieved high rates of implementation of audit recommendations.

- Consider a program facilitating partnerships between large industrial companies and ESPs as a means of fostering growth and promotion of the ESP sector. Publicizing the program will be important. ESPs may be drawn to join the program by benefits of publicity, such as being listed on the program website and being allowed to use the program logo and advertise their involvement.

- If refinement of Turkey's ESP certification program is desired, consider reviewing the systems recently designed in other countries. Findings from the report suggest that many countries have just recently designed (or updated) their ESP related certification programs. An example is the US's recent launch of Certified Practitioner of Energy Management Systems (CP EnMS).

- Recognize that SME industrial facilities and large industrial users may require different strategies and programs for developing ESPs to serve them. To address energy efficiency issues of industrial processes in SMEs, consider outreach to lean manufacturing programs and/or development of sector-specialized programs for clusters of SMEs. Another strategy may be to have EMS experts work with internal staff to identify energy saving opportunities.

- Consider leveraging various drivers that have promoted the ESCO and ESP industries in other countries. These may include:
  - Leveraging of donor financing for demos of ESCO projects and for promotion of ESCO financing in the banking sector. These donor measures have been seen to be effective before (e.g. financing of preparatory work for demos in Thailand; cooperation with commercial banks in China).
  - Development of standards and methods for monitoring and verification of results of industrial energy efficiency projects
  - Ensuring that policies treat ESCO implemented projects equally to host-implemented projects
  - Preferential tax treatment for energy efficiency projects and ESCOs
  - Subsidies, funds, and/or white certificates to support energy efficiency projects, including ESCO projects. Italy may be an interesting case with regard to tailored policy promoting ESCO involvement in white certificate projects.

International Experience with Energy Service Providers in the Industrial Energy Efficiency Market

Prepared to Support the Development of Energy Efficiency Services for Turkey's Industrial Sector

Prepared by Eugenia Katsigris of Parnon Group in October - December 2015 for the Government of Turkey/UNDP/UNIDO/GEF Project Improving Energy Efficiency in Industry (IEEI)

1. Introduction

This study reviews international experience with energy service providers (ESPs) in the energy efficiency market with emphasis on the industrial sector. The purpose of the study is to: (1) provide information on the situation of ESPs in several nations' energy efficiency markets with emphasis on the industrial sector and (2) provide insights on how Turkey can strengthen the segment of its ESP sector serving industrial firms. Strengthening the ESP sector is considered by many countries a key means of promoting energy efficiency. Yet, given that energy efficiency as a field lacks clear-cut boundaries and overlaps with other fields, the nature of ESPs if often unclear. Further, the nature and roles of ESPs serving the industrial sector differ from those of ESPs serving the government, institutional (e.g. schools, hospitals, etc.), and commercial building sectors. Thus, a review of ESPs in general and of ESPs working specifically in the industrial sector is needed to develop ESP-related strategies and plans for improving Turkey's industrial energy efficiency.

This section provides background on the scope and nature of ESPs and ESCOs (which, in this report, are considered a subset of ESPs). Clarification on these two concepts is needed because: (1) A nation's energy efficiency market is much more difficult to demarcate than other sectors. As mentioned, energy efficiency is not a neatly described sector with traditional boundaries. Instead, its activities tend to overlap with, but not fully encompass, a number of other sectors. (2) Terminology used to describe firms providing energy efficiency services varies among countries, policymakers, and experts. The scope these parties use to demark the energy efficiency sector also varies. Country estimates of things like energy efficiency markets, number of ESCOs, etc. are thus often not intercomparable. The different meanings ascribed to the term "ESCO," in particular, are a source of confusion.

This section also explains the purpose and approach of the study. The sections following then cover the situation of industrial ESPs in selected nations. Countries covered were selected based on potential to shed useful insights on industrial ESPs. Some countries were chosen due to their relatively large and advanced ESP sectors (not necessarily specific to industry) and advanced industrial energy efficiency levels. Others were chosen due to the relative

emphasis on the industrial sector among the nation's ESCOs or, more broadly, its ESPs. More information on country selection is given later in this section. Given the significance of Europe to Turkey, there is a section covering the situations of ESPs in each of three European countries. That section also covers the EU framework for promoting ESPs. Following the country analyses and coverage of the EU framework for ESPs, the report closes with overall recommendations for the Government of Turkey and Turkish Companies based on findings of the preceding analyses.

1.1 Energy Service Providers (ESPs) – the Broad Group

This report uses the term energy service provider (ESP) to refer to the broad group of companies providing energy efficiency and related energy services to customers. The decision to use this term is based both on (1) the practices of governments and experts (especially within the EU) and on (2) the need to ensure that the scope covered by the study will not exclude any important areas. EU legislators appear now to have settled on use of the term "energy service provider" with regard to promoting services in energy efficiency. The EU *2012 Energy Efficiency Directive* includes "energy service providers" in its definitions, rather than other such terms. The definition given in the *Directive* for ESP is: "a natural or legal person who delivers energy services or other energy efficiency improvement measures in a final customer's facility or premises."

Energy services versus energy efficiency services: Not all energy service provider work focuses on energy efficiency. While the intention of this report is firmly focused on providers supporting improvements in industrial energy efficiency, the study uses the broader term "energy service provider" (ESP) instead of the more focused term "energy efficiency service provider" (EESP). This is because the term ESP also encompasses companies that supply energy to customers, some of which are relevant to energy efficiency. Some types of energy provision, such as combined heat and power (CHP), are considered to have a strong energy efficiency component as they reduce total fuel consumption, but may not be considered "energy efficiency services." Some parties also consider renewable energy provision as having a strong energy efficiency component, because use of fossil fuels (or nuclear power) is reduced. Thus, while using the term ESP encompasses some service providers that have little to do with energy efficiency, by using the term, coverage of important industrial energy efficiency relevant areas, such as CHP, is ensured.

Given the scope of the term ESP, which may encompass some firms not relevant to energy efficiency, this report will strive to focus mainly on those ESPs that have relevance to energy efficiency. An alternative approach might be to use the term EESP, but define it to include direct energy provision (such as CHP) that is more efficient than the previously used energy source. Use of the term EESP as defined in this way would be more precise, but the term ESP was instead chosen for this report given the EU approach and common practice associated with use of the term ESCO, a key type of ESP that receives emphasis in this report. The ESCO term, like the broader ESP term, encompasses not only energy efficiency but also energy provision.

ESCOs versus ESPs: The term ESCO ("energy service company") is used in this report to refer to the subset of ESPs that are paid for their energy efficiency or energy provision services based on the performance of their installations. The EU *2012 Energy Efficiency Directive* similarly implies that ESCOs are a subset of ESPs. ESCOs generally provide a package of services, including both design and installation. By the definition used in this report, a company providing energy efficiency services for a set fee is not considered an ESCO, nor is one that simply audits a facility or designs a system, but does not handle installation. ESPs, then, in this report's definition include both fee-for-service companies and companies that are paid based on the success of their work (ESCOs).

Many proponents believe the ESCO concept is an attractive way to overcome the reluctance of clients to adopt energy efficient measures. If the ESCO takes on the performance risk of the equipment by tying its payment to performance, the client may be more likely to move forward with the measures. Further, ESCOs often provide (or at least arrange) the financing for energy efficiency installations. Thus, the client does not have to come up with a large sum of money at the start of the project and can instead pay the ESCO (or bank) back gradually in ensuing months and years from the energy savings that have reduced its energy bills. More information on the business models used by ESCOs is included later in this section.

Delineating the energy efficiency market and firms involved in the ESP sector: In order to analyze the energy efficiency market in a country, it would be necessary to delineate what is included and what is not included in that market. Yet, different parties may use different approaches. And, even when definitions of the market are the same, estimation is difficult. The various pieces of the market do not fit neatly into traditional market categories. Further, there tends not to be much diversity in the sources collecting data on the market.[226]

These difficulties, however, do not negate the value of studying the energy services market. Indeed, the EU *2012 Energy Efficiency Directive* presents a legal requirement for member states to monitor and evaluate their energy services market.[227] The requirement, however, perhaps recognizing the difficulties, is qualitative rather than quantitative. The approaches of some different sources shed light on how the market for ESPs may be defined. Below, two approaches from the literature are described (with summary provided in Exhibit 1-1). Then, the approach that has been used in this study is described.

LBL US Energy Efficiency Services Workforce Study: A workforce study on the US "energy efficiency services sector" by Charles Goldman et al of Lawrence Berkeley Laboratory (LBL) in California, for example, scans all areas that touch upon energy efficiency, but limits the scope of its workforce analysis to "the market supply chain that focuses on deployment and installation of energy efficiency products and measures." Reflecting these limits, companies focused on manufacturing and distribution of energy efficient products (whether discrete products, such as insulation, or integrated ones, such as appliances) are not included in the scope of LBL's workforce analysis. Those involved in (1) planning and project management, (2) consulting and auditing, (3) construction and installation, and (4) evaluation, monitoring, and verification are included. Those involved in operations and

[226]Ruth Offermann et al, *Monitoring the Energy Efficiency Services Market in Germany*, 2013.
[227]Offermann et al, 2013, op. cit.

maintenance are not included. Further, within the domain of "deployment and installation of energy efficiency products and measures," the authors limit the "energy efficiency services sector" to those energy efficiency "products and services whose demand is driven primarily by the energy savings."[228] Thus, it is possible that installation of some products highly beneficial to energy efficiency, such as industrial automation systems, would not be included if the primary reason for installation is not energy savings. For the four aforementioned areas, types of firms mentioned by the authors include: design and engineering firms, technical support service providers, accreditation consultants, implementation contractors, building and construction firms, insulation firms, and ESCOs.

Exhibit 1-1: Approaches in the Literature for Defining Energy Efficiency Services Market

LBL energy efficiency services workforce study[229]	**Offermann et al study on monitoring energy efficiency services sector[230]**
Included segments of supply chain – *"involved in deployment and installation of energy efficient products and services":* 1. planning and project management 2. consulting and auditing 3. construction and installation 4. evaluation, monitoring, and verification	**Three main areas of market to monitor:** <u>1. Energy advice and audit services</u>: onsite consultations and advice/plans <u>2. Energy management services</u>: energy consumption monitoring and control, related data analysis, benchmarking, and implementation and certification of energy management systems <u>3. Energy contracting services</u>: energy supply contracting/contract energy management, operation and maintenance management, energy performance contracting, and integrated contracting
Types of organizations in included supply chain segments: design and engineering firms, technical support service providers, accreditation consultants, implementation contractors, building and construction firms, insulation firms, ESCOs	
Excluded segments of supply chain: 1. manufacturing and distribution of energy efficient products 2. operation and maintenance	
Also excluded: Product and services whose demand is primarily driven by something other than energy efficiency	

Offermann et al Study on German Energy Efficiency Services Market: Offermann et al's study on how to monitor the German energy efficiency services market points out that simplification will be necessary if the market is to be monitored in a meaningful way, as required by the EU *2012 Energy Efficiency Directive*. They note that an earlier market survey (Clausnitzer et al, 2011) identified over 20 different subcategories of energy efficiency services, which would be too difficult to monitor. Instead, they suggest simplification and a focus on the most important areas, proposing the following three fields[231]:

[228]Charles Goldman et al, *Energy Efficiency Services Sector: Workforce Size and Expectations for Growth*, Lawrence Berkeley National Laboratory, 2010.
[229]Goldman et al, 2010, op. cit.
[230]Offermann et al, 2013, op. cit.
[231]Offermann et al, 2013, op. cit. The other study they refer to is referenced as: Clausnitzer, K.-D. et al, *Preliminary Study on Ways of Analyzing of the Market for Energy Services, Energy Audits and End-use Efficiency Measures*, (in the German language), commissioned by Federal Office for Energy Efficiency (FOEE), Bremen, 2011.

- Energy advice and audit services: onsite consultations and advice/plans
- Energy management services: energy consumption monitoring and control, related data analysis, benchmarking, and implementation and certification of energy management systems
- Energy contracting services: energy supply contracting/contract energy management, operation and maintenance management, energy performance contracting, and integrated contracting

Approach of this Study in Delineating the Industrial Energy Efficiency Services Sector: In deciding which type of organizations and services to include, this study will take a practical, purpose-drive approach. That is, the end goal is taken as enabling Turkey to increase industrial energy efficiency and the intermediate goal as developing an ESP sector that facilitates this. The purpose of this study is to support the intermediate goal by assisting Turkey in understanding: (1) the type of ESPs that have emerged and play a positive role in the industrial sectors of other countries and (2) what policies, programs, or other measures may support ESP development in Turkey. Thus, the study considers service providers that play (or could play) an important role in the facilitation of industrial energy efficiency, whether or not energy efficiency is the primary goal of hiring them. Even groups that are not associated with energy efficiency as the main goal, such as "lean manufacturing consultants" or engineering consultants focusing on manufacturing processes in a certain sector, could turn out to be important levers for achieving industrial energy efficiency. Indeed, while such groups may not currently be attaching much importance to energy efficiency, identification of their potential future role may suggest outreach to them.

The research for this study suggests three important dimensions to consider in identifying and describing ESPs in industry. These are summarized in Exhibit 1-2 and discussed here. The first dimension is the function of the ESPs. ESP functions may include consulting oriented services, such as energy audits, energy monitoring, planning and design of energy efficiency installations/ retrofits, and lean manufacturing training. It may also include installation and construction oriented services, including systems integration. In the case of ESCOs, it also includes provision or arrangement of financing. It may also include provision of energy, especially heat and power via CHP installations. The second dimension is the type of firm. Providers may be small consulting firms, large engineering consulting firms, distributors of energy efficient equipment (such as industrial or building automation) that also provide accompanying services, or ESCOs. Consulting firms may be specialized in a particular industrial sector or work across sectors. ESCOs may be independent firms (which begin as small entities) or subsidiaries of large equipment manufacturers or utilities.

The third dimension is the specific aspect of energy efficiency that ESPs address for their industrial clients. The US-based Alliance to Save Energy divides industrial energy use into three main categories: (1) industrial processes, (2) crosscutting equipment supporting industrial processes, and (3) the industrial facility/ building. It is important to consider all three areas in assessing the industrial ESP market to make sure none is ignored. The framework is also useful as different categories may be addressed by different types of service providers. In the US, the industrial processes category accounts for the majority of

overall industrial energy use and refers to process heating (involving furnaces and ovens that smelt and cure raw materials) and chemical reactions, distillation, and other processes to produce chemical compounds, plastic, steel, and other products. It most often makes direct use of fossil fuels, such as natural gas, petroleum, and coal. Cross-cutting equipment supporting industrial processes accounts for the second largest share (of the three categories designated here) of industrial energy use in the US and is typically powered by electricity. This equipment directly supports manufacturing and its processes. The cross-cutting category includes motor-driven equipment like pumps, air compressors, fans, and mixers, as well as combined heat and power generation, etc. It also includes material handling equipment that moves raw materials, intermediate product, and finished product within the factory. Facilities/ buildings aspects (of the three categories designated here) account for the smallest share of industrial energy use in the US and are usually powered by electricity. The most common areas of energy use are the building systems of heating, ventilation and air conditioning, and lighting. [232] An important point is that the energy efficiency services for cross-cutting industrial equipment and building systems (the second and third categories) may be handled by generalists working across industrial sectors, but that process related energy efficiency work may require service providers specialized in their customer's specific industrial sector. At the same time, those working in the cross-cutting equipment category may specialize deeply in a certain type of equipment, such as compressed air or fans, to best serve their industrial clients.

Exhibit 1-2: Three Dimensions Used in this Study for Identifying and Describing ESPs Serving the Industrial Sector

***Dimension 1*: Function**	***Dimension 2*: Type of Company**	***Dimension 3*: Aspect of industrial energy efficiency**
-Consulting oriented services: energy audits, energy monitoring, planning and design of energy efficiency installations/ retrofits, lean manufacturing training, etc. -Installation and construction oriented services: includes systems integration -Energy provision: especially CHP -Financing	-Small consulting firm (may or may not have expertise in processes of specific industrial sector) -Large engineering consulting firm (may or may not have expertise in processes of specific industrial sector) -Distributors of equipment facilitating energy efficiency such as automation equipment (provide services that complement their equipment, including audits, systems integration, and installation) -ESCO (service mix includes installation; paid on a success basis; rarely specialized in specific industrial sector; generally focused on building only; may be independent company or subsidiary of equipment manufacturer or utility)	1. Industrial processes (accounts for majority of US industrial energy use) 2. Cross-cutting supportive equipment (supports industrial processes; includes pumps, air compressors, fans, mixers, CHP equipment, etc.) (among three categories listed here, accounts for second highest share of US industrial energy use) 3. Facility/building (covers heating, ventilation, air conditioning, and lighting) (among three categories listed here, accounts for smallest share of US industrial energy use)

[232] Descriptions in this paragraph for each of the three main areas (processes, cross-cutting, and facilities) are based on explanations provided in: Alliance to Save Energy, *Industrial Energy Efficiency 101: The Basics Of How Industry Uses And Conserves Energy*, August 2012, accessed at https://www.ase.org/resources/industrial-energy-efficiency-101-basics-how-industry-uses-and-conserves-energy in October 2015.

1.2 ESCOs – a Subset of the Broad Group of ESPs

Definition of ESCO: As mentioned, different parties define ESCOs differently. Some define them relatively narrowly, as companies that design and implement energy efficiency projects and are paid via performance-based contract. The ESCOs defined in this way often provide or arrange for the financing for projects. Others define ESCOs more broadly, as any company involved in providing energy services. Research for this study suggests that those in Europe and North America that are most deeply involved with ESCOs or ESCO research now use the narrower, implementation and success based definition of ESCOs. Users of the more narrow definition include the US's National Association of ESCOs (NAESCO), the US Department of Energy's Lawrence Berkeley Lab (which frequently produces reports on the US ESCO market), and the European Commission's Joint Research Center for Energy and Transport (which has produced major, multi-country reports on national ESCO markets). This study also uses the more narrow definition. The scope of ESCO work (under this definition) ranges from projects specifically addressing energy efficiency (most commonly retrofits of building heating, ventilation, and air conditioning systems and lighting) to energy supply projects, such as CHP.

Attractiveness of ESCOs: While ESCOs for the provision of energy have existed for a long time in certain European countries, the concept of ESCOs to promote energy efficiency is newer, emerging in the US in the late 1970s and gaining popularity in the 1980s and 1990s. ESCOs are considered an attractive mechanism for overcoming barriers to energy efficiency projects. Barriers associated with the target hosts of energy efficiency projects include that they: (1) lack information about the benefits of energy efficiency, (2) are uninterested in energy efficiency investments because they are not a part of the company's or organization's main business, (3) lack the funds to finance the up-front costs of energy efficiency investments, and (4) are discouraged from pursuing ESCO projects due to uncertainty about realizing the expected benefits of the investments. ESCOs can address all of these barriers: In their marketing, they reach out to potential customers. They handle every aspect of the project so customers do not need to spend time on it. They often provide financing or arrange for third party financing so that the client does not need to come up with investment money up-front, but instead can pay for the project based on energy saved over time after installation. Finally, they assume the risk for project performance by agreeing to be paid based on energy savings or at least to guarantee those savings, so that clients do not have to worry about the uncertainty of results.

Type of ESCO Contracts: There are many potential variations in ESCO contracts, but these may be divided into three main types and a few main sub-types as described below. A summary of contract types is also provided in the top part of Exhibit 1-3.

1. Energy Performance Contracts (EPCs): EPCs are the most referred-to type of ESCO contract, though can often be the minority of such contracts in a country (particularly in European cases). The reason for their popularity in the literature, discussions, and promotion efforts is that the energy performance contracting is focused on energy efficiency projects and on removing the common barriers to them, such as those delineated above. EPCs are contracts by which the ESCO performs an energy efficiency retrofit project for a client. In an

energy performance contract, the ESCO's payment is contingent on the successful reduction of energy usage. There are two main types of EPCs:

a. Shared Savings EPC: In a shared savings EPC, the ESCO provides financing for the project either from its own investment funds or from a loan with a third party. The ESCO is paid back gradually by receiving a pre-agreed portion of the savings from reduction in energy use, with the other portion accruing to the customer. The better the project performs in terms of savings, the more the ESCO will benefit. Shared savings contracts are preferred in markets where the ESCO concept is new, as both the financial and technical risk of the project is borne by the ESCO rather than the client. A variation of the shared savings EPC is the "first out EPC," in which the ESCO receives 100 percent of the savings until the project costs and an agreed upon level of ESCO profit are reached.[233]

b. Guaranteed Savings EPC: In a guaranteed savings EPC, the client pays for the ESCO's services up front either through its own investment funds or via third party loan. Yet, the ESCO is still responsible for guaranteeing a certain level of energy savings. If the project falls short of the guarantee, the ESCO will need to reimburse the client or help it pay its debt service. If the project does better than the guarantee, the ESCO can reap additional financial rewards.

2. Energy supply contracting (ESC): Also known as "delivery contracting," energy supply contracting is focused on providing energy services, such as heating, lighting, or power. This is most often achieved by the ESCO supplying energy to the client and the client paying the ESCO for the energy based on a supply contract. For example, the ESCO may build and pay for a CHP facility at the client's industrial site and continue to maintain and operate this facility, with the client paying monthly energy bills to the ESCO.

a. Chauffage: Chauffage is a term developed in North America to describe a popular type of ESCO contract in Europe whereby the client agrees to pay the ESCO a fee for energy or other utility services. The fee is typically based on the client's existing utility bill, but with a certain level of monetary savings.

b. Power purchase agreement (PPA): PPA is a general term used in the US referring to an agreement guaranteeing the purchase of power for a certain price over a certain period of time. The PPA term is more general than ESCOs in scope and may, for example, refer to an agreement between a wind farm and a utility for power purchase over a 20 year period. In the case of an ESCO, a CHP project or other project serving a specific facility may be structured as a PPA.

c. BOOT contract: The BOOT model (build-own-operate-transfer) refers to the situation in which the ESCO designs, builds, finances, and operates the equipment for a period of time, during which there is a long-term energy supply contract with the client. After the designated

[233] Paolo Bertoldi et al, *European ESCO Market Report 2013*, EU Joint Research Center's Institute for Energy and Transport, 2014: Background information on contracts provided in this study is based on Bertoldi et al's explanations, as well as on similar explanations found throughout the literature and obtained via input from interviewees.

period is over (and the ESCO has recovered its cost and made a profit), ownership of the project is transferred to the client.

Exhibit 1-3: Main Types of ESCO Contracts and ESCO Financing

MAIN TYPES OF ESCO CONTRACTS
A. Energy Performance Contract (EPC)
Contract for energy efficiency retrofit project in which payment to ESCO is contingent on achieving the promised reduction in energy usage.
1. Shared Savings – ESCO provides or arranges financing. Is paid back gradually by receiving a pre-agreed portion of the energy savings, the rest of which is retained by the client. ESCO receives "upside" for greater than expected savings. 2. Guaranteed Savings – Client pays for ESCO's services up-front through own funds or bank loan. Yet, if project does not perform, ESCO will need to reimburse the client or assist with debt servicing. ESCO may receive "upside" for greater than expected savings.
B. Energy Supply Contract
Contract for supply of energy services, such as heat, electricity, or lighting. Client pays ESCO over time as energy/service is delivered. ESCO may build, pay for, and operate energy production facilities.
1. Chauffage - popular type of ESCO contract in Europe. Client agrees to pay ESCO a fee for energy/ utility services. Fee typically based on client's existing utility bill, but with certain level of savings. 2. Power Purchase Agreement (PPA) - term used in US for agreement guaranteeing purchase of power for certain price over certain period of time. PPAs are also used in power industry for generators that sell to utilities. In ESCO case, the PPA generally refers to power provided to a single facility. 3. BOOT Contract – "build, own, operate, transfer." ESCO designs, builds, operates equipment for a period, during which there is a long-term supply contract with client. After designated period, ownership is transferred to client.
TERMS USED IN DESCRIBING FINANCING FOR ESCO PROJECTS
1. ESCO Financing- ESCO provides project funds either through self-financing or third party loan. 2. Client Financing – client provides project funds either through self-financing or third party loan. 3. Project Finance – type of loan that is guaranteed through the expected income flows (e.g. for energy savings or energy provided), so that collateral is not required to secure bank loan. 4. Third Party Financing (TPF) – either ESCO or customer takes out loan to finance project. Ideally, project finance will be used, but more typically for energy efficiency projects, collateral is required to guarantee the loan. 5. Forfeiting – bank or other third party pays ESCO in full after project completed to purchase project receivables; customer then makes periodic payments to the bank or other third party.

Type of Financing of ESCO Projects: Common terms to describe types of ESCO project financing include: (1) ESCO financing refers to cases in which the ESCO provides funds for an ESCO project, either through its own funds or through a third party, typically a bank. (2) Customer financing refers to cases in which the customer, either through its own funds or third party financing, provides the up-front funds for the project. In this case, the ESCO handles only the management and engineering for the project, taking on the technical performance risk only. (3) Project finance refers to form of financing whereby collateral is not required by the bank, but the project is instead "guaranteed" through the expected income flows of the project (whether they be energy savings or energy provided). In practice, project finance for ESCO projects is difficult to achieve in many countries. The banks, instead, usually require some form of collateral for energy efficiency projects, just like for standard loans. ESCO energy supply contracting, more similar to the kinds of projects seen in the

project finance world, may be more likely to achieve project finance arrangements. (3) Third Party Financing (TPF) may be a form of either ESCO financing (ESCO is the borrower) or customer financing (customer is the borrower). Ideally, this type of financing would be achieved through project finance, though most often some form of collateral is required. (4) Forfeiting refers to a contract structure in which the bank or other third party pays the ESCO in full after the completion of installation to buy the receivables of the project.[234] The customer then makes fixed payments to the bank over time. Explanations for these ESCO project financing terms are summarized in the bottom part of Exhibit 1-3.

Barriers to ESCOs: Sources researched for this study generally agree on some of the main barriers to the development of ESCOs and ESCO projects. In many countries, lack of access to financing is the major barrier. Especially when a nation is trying to develop a new ESCO industry and grow a group of "baby ESCOs" into mature players in the market, these small companies, lacking collateral, are often unable to obtain bank loans. Also, because the industry is new and the providers lack track records, customers are hesitant to finance projects themselves. Lack of project finance for such projects (which would alleviate the need for collateral) is also a barrier. A related problem is lack of understanding on the part of financial institutions about ESCO projects. Another key barrier is the potential clients' lack of understanding and familiarity regarding the upside of energy efficiency projects and of ESCOs in particular. This may result in a low level of trust in the ESCOs. Low prices of electricity hinder ESCO projects (as they hinder other forms of energy efficiency projects). Overly burdensome administrative requirements and procedures in bringing a project deal to closure result in high transactions costs, so that only very large projects merit the effort required by the ESCO model. For example, the need to determine baseline energy use and agree on rules for measuring and validating reductions in energy use, introduce complexities that may be absent in non-ESCO projects.[235]

Drivers of ESCOs and Recommended Methods of Promotion: Aside from the long-enduring energy supply contract business in Europe, the emergence of ESCOs was initially sparked by the energy crisis in the US in the late 1970s. Growth since then has largely been driven by policy and provision of outside funding for energy efficiency projects. In the United States, for example, ESCOs began to flourish in the mid-1980s to mid-1990s when utility regulators forced utilities to institute programs to achieve efficiency at the facilities of their clients ("demand side management" or DSM). In the initial stages of the ESCO market in the US, in the shared savings model, it was the utility rather than the client that paid the ESCO back over time for its investment. The contract amounts were at first generous and

[234]SUSI Partners, a European entity that is running a €250 million Energy Efficiency Fund now in its investment phase, offers ESCOs three forms of financing from its fund. One of these, which is termed (a) "true sale of receivables" is similar to "forfeiting" described here. In this model, SUSI finances the whole project by buying part of the receivables from the ESCO. The other forms of financing SUSI offers are: (b) "operating lease," where, after installation, SUSI buys the equipment from the ESCO and leases it back to the ESCO; and (c) SUSI establishment of "special purpose vehicle," which pays the ESCO for the full cost of the project and then receives service payments from the client.

[235]The foregoing barrier discussion draws from Edward Vine, "An International Survey of the ESCO Industry," *Energy Policy*, 2005

very profitable for the ESCOs, thus enabling the industry to gain a foothold.[236] Now the industry in the US successfully carries out large building energy efficiency projects, particularly in the government and institutional sectors, where the ESCO is paid back over time by the client. In China, a World Bank project provided Global Environment Facility (GEF) funds directly as grants to the first three ESCOs to ensure they were capitalized enough to finance projects. In other countries, international development organizations have set up funds supporting ESCO projects.

Means for promoting ESCOs and ESCO projects have been reviewed extensively in the literature. Some measures recommended include increasing information flowing to potential end users about the types of projects and financing provided by ESCOs. When utilities are involved in financing, they have often played the role of information conduit to their customers. Another important measure is to ensure that the services provided by ESCOs are of high quality, so that the ESCO industry maintains a positive reputation. This may be achieved by an accreditation system, such as that carried out by the National Association of ESCOs (NAESCO) in the US. Another important area for promotion is identifying potential financial institutions for involvement and building their knowledge about ESCOs and ESCO projects. As experienced in the cases of initiating the ESCO industry in the US and China, providing funding to the industry in its early stage in a country, such as through utility financing of ESCO projects or through capitalization of emerging ESCOs, is a strong potential driver. A more equitable approach (i.e. spreading funds more broadly among beneficiaries) may be funding energy audits and other up-front work, though it is important to develop a program in which there is substantial follow up on the recommendations of the audits. Standardizing of contracts is another way of promoting the ESCO industry by eliminating or reducing problems that come to the parties from not having understood the implications of their contracts. Turkey is already pursuing work in the design of standard EPC contracts under a World Bank project. Standardization of measurement and verification procedures for ESCO projects would also help to mature the industry. ESCO demonstration projects could promote the industry, as could cooperation between larger ESCOs from developed ESCO markets and local emerging ESCOs. Establishment of equipment leasing organizations may also promote the market if such organizations focus on contracts for leasing energy efficient equipment. Finally, legislation for promoting ESCOs is a potentially powerful promotion mechanism. For example, rules requiring utilities to achieve a certain level of energy efficiency projects among their customers, which launched the US ESCO industry, can be a powerful driver. Further, regulations friendly towards ESCO projects, including relevant government procurement rules and favorable taxation rules, can also promote the industry.[237]

[236]Personal communication with Mr. Donald Gilligan, President of the US's National Association of ESCOs (NAESCO), provided strong insights into the history and drivers of ESCOs in the US, as referenced here and elsewhere in this study.

[237]The foregoing discussion on means of promoting ESCOs draws largely from Edward Vine, 2005, op. cit.

1.3 Purpose and Content of this Study

Target audience and goals of this study: This study was conducted as a part of the project *Increasing Energy Efficiency in Industry* (IEEI), carried out by the Government of Turkey, the United Nations Development Program (UNDP), and the United Nations Industrial Development Organization (UNIDO) with Global Environment Facility (GEF) funds. The main target audience of the study is relevant stakeholders in the Government of Turkey, existing or potential industrial sector ESPs in Turkey, and potential industrial clients of these ESPs. Other stakeholders with an interest in understanding and promoting industrial energy efficiency via ESPs in Turkey or other countries may also find the study of interest. The ultimate end goal inspiring the study is to increase industrial energy efficiency in Turkey. The study hopes to make a contribution to this goal by providing stakeholders with information needed to develop plans and strategies for developing ESPs serving the industrial sector in Turkey. These plans and strategies may be plans for the sector as a whole (e.g. government plans and policies), plans for developing individual ESPs (ESP business plans and strategies), or plans for retaining/utilizing ESPs in individual projects (industrial end users' plans for retaining and working with ESPs). The study aims to give stakeholders a view of what types of companies providing what types of services have thrived in the industrial ESP markets of other countries and made contributions to industrial energy efficiency. In this way, it is believed, stakeholders will be better prepared to make the plans to build and leverage the industrial ESP sector in Turkey.

To further elucidate the aims of this study, it is useful to look at the present situation of the Turkish ESP sector. At the time of initiation of this study, there was strong interest in ESCOs and the EPC model, in particular, but questions regarding how applicable these are to the case of Turkey's industrial sector. So far, there are a number of companies in Turkey providing energy efficiency consulting services. There have been about 18 EPC projects in the country, mostly carried out by one company.

A group of roughly 35 energy efficiency consulting companies have obtained certification to operate as EVDs in Turkey. EVD is an abbreviation based on the Turkish term for "energy efficiency consulting company." Certification must be updated annually and is provided by YEGM, Turkey's Directorate of Renewable Energy under its Ministry of Energy and Natural Resources. Some of the EVDs are certified to operate in industry; some are certified to operate in the building sector; and some hold both types of certifications. Turkey has plans to increase the number of EVDs certified to operate in industry. End users in industry must use a certified EVD if they wish to obtain government grants associated with voluntary agreements for reducing industrial energy consumption. Yet, at present, a much greater amount of funds is available from other sources, such as EBRD, and such funds do not require certification.

Also of note is that, while a good number of industrial energy audits are being conducted in Turkey, the quality appears uneven and quite weak in several cases. Some audits have been conducted by small, independent energy efficiency consulting companies. Others have been conducted by larger, international providers that manufacture equipment, but also provide energy consulting services. The Government would like to ensure a diversified ESP sector

that is not dominated by the equipment manufacturers and their distributors, but includes independent consultancies as well. Yet, a challenge is presented in that the equipment manufacturer audits tend to be of better quality than some of the others seen.

Methodology: The purpose, scope, and content of this study was refined with input from the IEEI Project Coordinator and the IEEI Project Senior International Technical Advisor, both of whom also provided insightful guidance as research was conducted. The research included extensive review of the literature on ESPs in general, ESCOs in general, and the situation of each in key countries of interest. Selection of key countries of interest is explained later in this section. The research also included in-depth interviews with selected sources and written exchanges with such sources. Given the number of countries and the time-scale for the study, a decision was made to research some countries with greater depth than others.

Content of study and rationale behind country selection: The study covers the situation of ESPs generally and in the industrial sectors of each of the US, China, Japan, Ukraine, Thailand, South Korea, Germany, Italy, and Great Britain. It also includes a sub-section reviewing the EU policy and program framework for ESPs and ESCOs. The individual country research touches on a number of areas. The depth of coverage in this report with regard to each area depends on the relevance and extent of findings for each country, respectively. Among the most important areas researched in the country analyses are: (1) overall ESP and ESCO market, including history (how the industry developed) and current situation; (2) the industrial ESP and ESCO markets, including the types of projects, services, and customers; (3) the types of companies serving as ESPs generally and as industrial ESPs, including profiles of individual industrial ESPs; (4) policy and programs supporting ESPs and supporting industrial energy efficiency with a role for ESPs; and (5) financing of ESP projects.

Selection of countries for review: In selecting countries for ESP sector review, considerations included: (1) development level (with both developed and developing economies of interest), (2) large industrial sector, (3) size of country (countries with larger populations preferred; note: population of Turkey is about 75 million), (4) size of ESCO market (larger market preferred), (5) reported role of industrial sector in ESCO market (large role of industrial sector preferred), and (6) role of small and medium sized enterprises in industrial sector (significant role preferred). While this study is to cover ESPs generally and not just the more narrowly defined ESCOs, ESCO markets played an important role in country selection because: (A) ESCO markets have been more deeply studied and quantified across nations than ESP markets, which are more difficult to define. (B) A key question facing this study is whether it makes sense for Turkey to push strongly for ESCOs in the industrial sector or instead focus on fee-for-service ESPs or a mix of the two. Various cross-country ESCO studies were referenced to gather information on the two ESCO criteria (items 4 and 5 listed in this paragraph), with two EU Joint Research Center ESCO studies (one on EU countries and one on non-EU countries) being the most referenced.[238]

[238] Paolo Bertoldi et al, 2014, op. cit., and Strahil Panev et al, *ESCO Market Report for Non-European Countries 2013*, EU Joint Research Center's Institute for Energy and Transport, 2014.

Exhibit 1-4 provides a summary by selected country of key findings and factors leading to selection. Overall, selected countries, based on initial findings, fell into roughly three groups, although there were variations: (a) populous, developed Western countries with relatively large ESCO markets, but with industry holding a small share in the ESCO market; (b) developing countries (large and medium-sized) in which industry reportedly holds a large share in the ESCO market; and (c) populous, developed East Asian countries in which industry reportedly holds a large share in the ESCO market.

Exhibit 1-4: Factors Leading to Selection of Country for ESP Sector Review

Country	Situation and Rationale for Inclusion
1. USA[a]	- Large ESCO market, but industrial sector has very small share (industrial and commercial sector together made up 8% of ESCO market in 2011) -Developed country; large population (319 million); large industrial sector
2. China[c]	-Strong ESCO market; majority industrial. Some say EPC strong, others say limited; many of the industrial ESCOs may be companies with their own technology/IP - Developing country; vast population (1.36 billion); very large industrial sector
3. Japan[b]	-Significant ESCO market; industrial sector has large share, though commercial sector share is growing; industrial sector may have less EPCs than building sector; ESCOs are mostly departments of large companies -Developed country; large population (127 million); large industrial sector
4. Ukraine[c]	-ESCO (or ESP) market said to be developing well, though funded mainly by donors; industrial sector believed to have strong potential for ESCO projects -Developing country; medium-sized population (45 million); substantial industrial sector
5. Thailand[c]	-ESCO market said to be developing well and to be mostly industrial -Developing country; medium-sized population (67 million); substantial industrial sector
6. South Korea[b]	-Strong ESCO market that is mostly industrial -Developed country; medium sized population (50 million); large industrial sector
7. Germany[a]	-Strong ESCO market, though most is energy supply contracting (ESC) rather than EPC; industrial projects have very low share in ESCO market -developed country; medium-large populace (81 million); very large industrial sector; known for strong role of small and medium sized enterprises in manufacturing sector
8. Italy[a]	-Mixed progress of ESCO sector; public sector largest segment of ESCO market; industrial segment of ESCO market said to be growing but constrained by financing -developed country; medium-sized population (60 million); substantial industrial sector with strong role played by SMEs
9. UK[a]	-Significant ESCO sector; public sector building projects most common, but industrial sector plays a role in ESCO market; energy supply contracts most common -developed country; medium-sized population (64 million)

[a]fits in rough categorization of developed Western countries with relatively large ESCO markets, but with industry holding a small share in the ESCO market; [b]fits in rough categorization of populous, developed East Asian countries in which industry reportedly holds a large share in the ESCO market; [c]fits in rough categorization of developing countries (large and medium-sized) in which industry reportedly holds a large share in the ESCO market.

Sources: Main sources are Bertoldi et al, 2014, op. cit.; Panev et al, 2014, op. cit.; Elizabeth Stuart et al, *The U.S. ESCO Industry: Recent Trends, Current Size and Remaining Market Potential*, ACEEE 2014 Summer Study on Energy Efficiency in Buildings, 2014.

In carrying out country selection research, the most prominent result is that most countries of interest reporting a large share of ESCOs in the industrial sector (whether developed or developing) are Asian countries. The author considered whether this may be tied to the more

industrial nature of their economies or perhaps institutional characteristics that these countries share in common. At the same time, it was considered equally possible that conceptual issues were "lost in translation." That is, while Western countries used the more narrow definition of ESCO (for which payment is performance based) in reporting for the EU studies, perhaps East Asian countries used a broader definition encompassing fee-for-service ESP models.

2. US Case

With the largest economy in the world, the US has for years had the world's largest ESCO market. It probably has also had the world's largest ESP market, though there is less data, making inter-comparison more difficult. Only very recently has China's ESCO market begun to rival the US's in scale. Within the US ESCO market, industrial ESCO projects have a very small share. This finding may have important implications for Turkey. The reasons for the small share of industrial ESCOs, discussed in this section, suggest the ESCO model may not fit well with a developed industrial sector. A less modernized industrial sector, with "low-hanging fruit" in energy efficiency and thus shorter payback times, may better accommodate industrial ESCOs. The energy service providers most commonly found in the US industrial sector are engineering consulting firms and vendors of equipment that has energy efficiency benefits to industrial processes. These ESPs work on a fee-for-service basis, rather than a on a success basis. They may be a good target for capacity building in countries that wish to develop their industrial ESP sector. Another important finding about the US case is that most small and medium sized industrial companies tend not to retain outside help to improve energy efficiency. As a result, government supported audits provided free to these companies and carried out by university students led by experienced instructors may be the most important type of ESP in the US industrial SME segment. The US Government, both through this small industrial company audit program and through programs targeted at larger industrial facilities, is proactive in promoting industrial energy efficiency. Some of this government work, such as certification programs for energy managers (US Department of Energy SEP Program) or partnering energy efficiency service providers with industry (US Environmental Protection Agency Energy Star Program), appears to have a positive effect on strengthening the nation's industrial ESP sector.

2.1 Overall US Market for ESPs and ESCOs

This subsection addresses the market for ESPs and ESCOs overall in the US economy. Subsequent subsections will then move to the more narrow focus of the roles of ESPs and ESCOs in the US industrial sector. As with this study as a whole, ESCOs are defined more narrowly as energy service providers whose payment is linked to their performance. ESPs are defined more broadly to include both ESCOs and those providers whose payment is fee-for-service based only.

While data on ESCOs has been carefully collected and studied, data on the ESP sector overall is less available and more difficult to assess, given the varying scope researchers use to define the sector. One study on the energy efficiency workforce in the US estimated that, in 2008, there was an annual energy efficiency services workforce of 114,000 person-years, of which about ten percent was realized through ESCOs.[239] The same study put US 2008 spending on energy efficiency services at USD18 billion. This compares to an estimate of US ESCO

[239] Charles Goldman et al, *Energy Efficiency Services Sector: Workforce Size and Expectations for Growth*, Lawrence Berkeley Laboratory, 2010.

revenues that were energy efficiency focused of USD3 billion in 2008.[240] These numbers are dated; and the definition of energy efficiency services challenging. Yet, on a general level, the numbers imply that ESCO energy efficiency services are a significant but minority share of overall energy efficiency services in the US.

2.1.1 History of ESCOs in the US (General)

The history of ESCOs within the US provides insight on drivers that led to the development of the industry. In retrospect, regulatory drivers in the US resulted in attractive financial resources for ESCO projects. These financial resources were the most important force in giving rise to the industry and enabling it to take hold in the US. The drivers resulted in utilities being the ones to pay ESCOs back over time for energy saved.

The US ESCO industry evolved out of energy consulting firms, which in the late 70s and early 80s were carrying out government supported audits at institutions such as hospitals.[241] Unfortunately, few of the audits were followed up upon. The initial ESCOs were formed during this period. Yet, the energy utilities were still expanding their capacity due to the incentive structure of the industry in the US. In that structure, the rates utilities were allowed to charge were based on their capital investment, resulting in substantial overcapacity. At the same time, there was a move to promote energy conservation with the issuance of the Public Utilities Regulatory Policy Act (PURPA), which became law in late 1978. By the late 80s to early 90s, there was a stronger move to stop the overbuilding and require utilities to institute energy efficiency programs, rather than build new power plants. At first in such programs, the utilities would pay for energy saved at a rate equivalent to the cost of generation avoided. This resulted in a high price per kWh and fantastic profits for ESCOs. For example, based on cost of generation avoided, the utility might end up paying ninety USD for a CFL light bulb. Initially, the best customers were in the industrial sector, because they tended to have the lights on and be operational for long periods, resulting in attractive payback times for ESCO projects. Yet, this has since changed dramatically, a trend that will be examined later in this section.

During this early period, the ESCOs took on both the technical risk with the equipment and the financial risk of the projects.[242] Yet, there was not much risk with the technology, though non-experts perceived one. Further, because the utilities were paying back the loans, the ESCOs did not have to worry about the credit of the end user. Indeed, the early projects were very profitable. The technologies were building focused, mostly lighting and controls. The ESCO industry in those early stages was mainly small, entrepreneurial companies and a few subsidiaries of utilities. Soon, the equipment manufacturers, such as Honeywell and Johnson Controls, joined, as they wanted to sell their building control equipment. They began to leverage their national networks of offices and existing relationships with customers.

[240] Andrew Satchwell et al, *A Survey of the US ESCO Industry: Market Growth and Development from 2008 to 2011*, Lawrence Berkeley Laboratory and National Association of ESCOs, 2010.
[241] This paragraph is based extensively on an interview with Donald Gilligan, President of the US's National Association of ESCOs (NAESCO), on October 30, 2015.
[242]This paragraph is based extensively on an interview with Donald Gilligan, Oct. 2015, op. cit.

Eventually the utility industry stopped paying so much for the saved energy.[243] At first they said they would no longer pay for the full cost of avoided energy, instead capping the level of payment at the equipment cost. Then, later they reduced the amount they would pay to 50 percent of equipment costs. Now, it's down to about 25 percent of equipment costs. In general, now the utilities are no longer paying or are no longer paying the majority of costs. So, the customer base has shifted from industry to those who are interested in paying and are expected to be around for the full duration of the contracts: government and institutional clients. The main focus of ESCO projects continues to be building technologies, although there has been some diversification within the building technology segment.

2.1.2 US ESCO Market (General)

Market size: The size of the 2011 US ESCO market was estimated to be about USD5.3 billion. A projection for the 2013 market size, made in 2012 and now widely quoted, is USD6 billion. It has been indicated that there were 45 true ESCOs in the US in 2012.[244] This count is based on a definition of ESCOs that requires performance contracting be part of their work. Stewart et al, writing in 2014, projected continued strong growth and estimated the annual US ESCO market could grow to USD11 to 15 billion by 2020. Their projection was based on current trends, including government programs. Based on the type of buildings ESCOs work with, Stewart et al estimate the cumulative remaining market potential for ESCOs in the US to be USD70 to USD130 billion. The estimate is based on an aggregate amount of buildings that have not been retrofitted and could benefit from an ESCO project. It does not include potential market revenues from upgrading, after some time, buildings that have already been retrofitted once before.[245]

Customers: Exhibit 2-1 below shows the breakdown of the US ESCO market by customer sector, based on a 2012 survey of 35 of the 45 true ESCOs thought to be active at that time. The data shows the predominance of government buildings (local, state, and federal) and institutional buildings (schools, hospitals, and public housing), which together account for 88.6 percent of all ESCO revenues. The commercial building market and industrial clients are grouped together, and account for only 8.1 percent of ESCO revenues.[246]

Looking at the cases of individual ESCOs yields a similar picture. Ameresco, the largest and probably most successful independent ESCO in the US, for example, gets the majority of its business from government agencies and nonprofit institutions, such as universities and hospitals. Since these can't always afford the upfront costs of multimillion-dollar projects, they find the ESCO model (with ESCO financing) attractive.[247]

[243]This paragraph is based extensively on an interview with Donald Gilligan, Oct. 2015, op. cit.
[244]The preceding market size estimates correspond roughly to the revenues of the 45 true ESCOs, encompassing both their ESCO and non-ESCO business.
[245]Data in this paragraph is based on Elizabeth Stewart et al, *The US ESCO Industry: Recent Trends, Current Size, and Remaining Market Potential*, ACEEE 2014 Summer Study on Energy Efficiency in Buildings, 2014.
[246]The survey mentioned in this paragraph was conducted by Lawrence Berkeley Laboratory and the US's National Association of ESCOs. Results in the paragraph are based on Stewart et al, 2014, op. cit.
[247]Jay Fitzgerald, "Energy Services Firm Profits with Boring Efficiency," *Boston Globe*, Sept. 11, 2012.

Exhibit 2-1: ESCO Revenues by Customer Sector (based on survey of 35 of 45 true ESCOs)

Sector	Share of Total 2011 ESCO Revenue	2011 ESCO Revenue in Sector (USD)
State/local government buildings	24.0%	1.234 billion
Federal government buildings	21.4%	1.102 billion
Kindergarten, elementary, and secondary schools	19.4%	995 million
Universities and colleges	13.7%	702 million
Commercial buildings and industrial clients	8.1%	419 million
Healthcare and hospitals	5.9%	302 million
Public housing	4.2%	217 million
Other	3.3%	168 million
Subtotal (for 35 of 45 ESCOs)	100%	5.138 billion
Estimated total market including all 45 ESCOs	--	5.263 billion

Source: Elizabeth Stewart et al, 2014, op. cit.

Types of projects of US ESCOs by technology: Stewart et al (2014) indicate that 85 percent of the revenues of the 45 US ESCOs in 2011 is related to energy efficiency. In terms of types of projects, the US ESCO sector is focused predominantly on building energy efficiency. Even when the client is an industrial customer (such as in recent General Motors ESCO deals), ESCO projects tend to be building focused. Goldman (2011) divides the overall US ESCO project market by 2008 revenues into energy efficiency (75 percent), onsite renewables (14 percent), engine/ turbine generators (6 percent), consulting/master planning (3 percent), and other (2 percent). In terms of more specific types of technologies, he notes that lighting and heating-ventilation-and-air conditioning (HVAC) controls are the most commonly installed measures. Yet, looking at a database of 656 ESCO projects carried out between 2005 and 2008, he notes that the share of lighting projects in overall number of projects had dropped precipitously to three percent of projects. At the same time, "major" and "minor" HVAC projects together accounted for 59 percent of all projects. Distributed generation accounted for 11 percent of projects, while non-energy projects accounted for 24 percent.[248] Navigant, a consulting firm which recently prepared a report on the US ESCO industry, includes the following types of projects in describing the US ESCO industry: "retrofits for lighting, heating, ventilation, and air conditioning (HVAC) and mechanical systems, renewables, water conservation, commercial building automation systems (CBASs), and building energy management systems (BEMSs)."[249]

Type of projects of US ESCOs by contract type: The 2014 Lawrence Berkeley Laboratory (LBL) study of the US ESCO market (Stewart et al, 2014) divides contract type into the following areas, also giving share and amount of 2011 ESCO market revenues: (1) energy performance contracting (69 percent of ESCO revenues or USD3 billion), (2) design/build projects (15 percent or USD660 million), (3) utility program administration (7 percent), (4) consulting, (3.9 percent), and (5) onsite generation power purchase agreements (3.6 percent). By design/build projects, the authors are referring to fee-based contracts for services like engineering, procurement, installation, and construction. These contracts do not include any

[248]Charles Goldman, "US Energy Service Company (ESCO) Industry and Market Trend," Presentation at the *Second US China Energy Efficiency Forum*, 2011.

[249] Navigant website introduction to 2015 ESCO report. Accessed Oct. 2015 at http://www.navigantresearch.com/newsroom/the-u-s-energy-service-company-market-is-expected-to-reach-11-5-billion-a-year-by-2024.

kind of guaranteed savings or long-term performance risk on the part of the ESCO. Of course, the fee-based design-build market size indicated here is only that ascribed to ESCOs (defined by the authors as companies that have a significant share of their business performance based). It is likely that a much greater amount of energy efficiency related design-build revenues may be attributed to non-ESCOs. The category of consulting contracts, according to the LBL team, includes audits, engineering studies, and project and subcontractor management. Some ESCOs implement energy efficiency programs for utilities. Most often such programs are aimed at the small commercial, and sometimes industrial, companies. Finally, in a power-purchase agreement, the ESCO installs and operates onsite energy generation, selling the energy to the customer/host.[250]

Typical project scale, savings, and payback: The average scale of US ESCO projects is substantial -- in the low multi-million US dollar range -- and has grown over time. Goldman (2011), looking at a database of 2,891 ESCO projects implemented in the US from 1990 to 2008, provides average project size by customer type. He finds that federal government and university projects both averaged around USD2.2 million in the size of their ESCO projects; kindergarten, primary, and secondary schools and local government building projects averaged USD1.5 million; hospital projects averaged USD1million; public housing projects averaged USD1.9 million; and private sector building projects averaged USD500,000.[251] Goldman (2011) further finds that per project investment levels had increased over time even after accounting for inflation. He concludes that this is the result of customer demand for more comprehensive projects, such as on-site generation and non-energy installations. Yet, he also notes the possibility that ESCO labor and material costs were increasing faster than inflation. By the 2005-2008 time range, his data set of projects were averaging project size of USD6.5 million per project in the public sector and USD3.2 million per project in the private sector.

Annual energy savings of US ESCO projects has been indicated to be in the 20 to 40 percent range, depending on project type. Across the 1990 to 2008 data set of projects for which there was data on energy savings (about 1,260 projects), Goldman (2011) found that HVAC projects typically saved 25 percent of their baseline (pre-installation) energy consumption. He found that lighting-only retrofit projects typically saved 30 to 40 percent of baseline lighting energy use. According to one article, Ameresco (the largest independent US ESCO) claims average energy savings of 35 percent per project, though the industry average is considered to be 20 percent. In a USD63 million Ameresco project across 13 sites conducted for the Boston Housing Authority (contract signed in 2010), annual savings on utility bills was indicated as USD5million. This savings includes a five percent reduction in electricity consumption, 36 percent reduction in natural gas usage, and 37 percent reduction in water consumption.[252]

Payback times are quite long for public sector clients, though shorter for the private sector projects and lighting projects. Looking at the aforementioned 1990 to 2008 ESCO data set (with 2,480 projects with relevant information), Goldman (2011) found that payback times

[250]Information in this paragraph based on Elizabeth Stewart et al, 2014, op. cit.
[251]Goldman, 2011, op. cit.
[252]Last three sentences in paragraphs are based on op. cit., Fitzgerald, 2012, op. cit.

were typically seven to nine years for the public sector projects, four years for private sector projects, and two to three years for lighting only projects.

Financing and policy: In the US case, financial incentives resulting from government policy have been a major driver in the development of the ESCO industry. These financial incentives continue, along with other policies, to play a large role in the industry today. The historical impact of utility programs (in which utilities initially paid for ESCO projects in full) has been described above. Yet, an additional point highlighting the critical nature of policy to the early stage development of the US ESCO industry comes from looking at the changes in the industry from 1984 to 1985. In 1984, the US ESCO industry association was brand new and going strong. Within one year, the association and industry crumbled as the tax credits on which the industry was based were removed by the federal government.[253] (The tax credits provided a dollar reduction in taxes due for every dollar spent on an ESCO project and were thus very attractive.)

More recently, incentive programs, including those implemented by utilities and those implemented by the federal government, continue to stimulate the US ESCO sector. Utility incentive programs are generally paid for from funds collected via charges across the utility's customer base. A 2005 survey of ESCOs in California, conducted by the California Energy Commission (CEC), found that one-third of the projects of surveyed ESCOs participated in utility incentive programs that reimbursed investments based on actual energy saved. This study also found that surveyed ESCOs in California did not usually provide financing, but instead assisted clients in securing project funding. One reason for this may have been that public agencies, a large portion of the ESCOs' customer base, qualify for tax exempt financing that results in lower interest rates than those for financing provided by ESCOs.[254]

An LBL study (2013) on US ESCOs similarly finds a large role played by outside financial incentives in the overall ESCO project mix. The study looks at: (1) federal incentive programs (grants and loans to projects), (2) federal, state, and local tax credits (whereby taxes are reduced dollar-for-dollar based on money invested in ESCO projects), and (3) utility customer-funded financial incentives. The study finds that each of these three incentive types plays a significant role in the US ESCO industry. Surveying 30 ESCOs, the LBL team found that 30 percent of the projects of medium and large ESCOs (of which there were eleven such ESCOs in the survey) received federal incentive funds, while 15 percent of the projects of small ESCOs (of which there were 19 in the survey) receive such funds. Of 29 ESCOs responding, the majority had made use of tax credits to some degree, with eight indicating tax credits were used for more than half of their projects. Of the 30 ESCOs, 27 indicated that some portion of their projects used utility provided financial incentives (e.g., rebates, no-cost or subsidized audits, engineering studies, or technical assistance). For the 18 small ESCOs responding, in aggregate utility incentives played a role in 80 percent of their projects, suggesting this incentive source is particularly important to small ESCOs.[255]

[253]Personal communication with Mr. Rod Janssen, energy expert and editor of *Energy-in-Demand*, a top sustainable energy newsletter, October, 2015.
[254]Virginia Lew, Principal Author, *Summary of Energy Service Companies – Summary of Responses*, California Energy Commission, Jan. 2005.
[255]Elizabeth Stewart et al, 2013, *Current Size and Remaining Market Potential of US ESCO Industry*, Lawrence Berkeley Laboratory.

While comprehensive data is not available on the financing models used for US ESCO projects, it appears a large portion of these are financed by the customer. And, surprisingly, when the customer is financing, they often do so by full up-front cash payment. The 2013 LBL study queried its survey group of 30 ESCOs on type of financing vehicle used for ESCO projects. For the 19 ESCOs doing projects in federal buildings, in 40 percent of their federal building projects as a group, the government customers paid the ESCO up front in cash. Typically this money came from programs that had funds available for such projects. About 19 percent of federal projects used leases and 31 percent used other methods, which may involve the ESCO taking on financing risk via bank loan. Up-front cash payment by the customer to ESCOs was less common in the institutional sector, but still significant (e.g. 33 percent in hospitals/healthcare and 20 percent in universities). It was highest -- 50 percent -- in the private sector (commercial and industrial clients).[256]

In addition to aforementioned financial incentive policies (subsidies and tax credits), other types of policies have also promoted the ESCO market in the US. These include (1) early legislation that allows long-term performance contracts in institutional markets and more recent developments, such as (2) the use of building energy benchmarking and energy disclosure policies by cities and (3) the adoption of energy efficiency goals by state and local governments.

Barriers: The most significant barriers to US ESCOs occur in the private sector, including the commercial building and industrial sectors. Barriers specific to industry will be discussed later in this section. The issues constraining private sector ESCO projects in general are that private sector clients are averse to both: (1) long-term contracts and (2) allocating funds for non-core business activities. One result of the private sector's aversion to long-term contracts is that a large portion of private sector ESCO projects are paid for in cash up front by the client and have short payback times of a couple of years. One potential solution for broadening the project mix to include projects with longer payback times that is being investigated is providing insurance to reduce the risk to private sector customers involved in ESCO contracts.[257]

2.1.3 US ESCO Companies (General)

Staffing and outsourcing of installation function: While US ESCOs handle large installation projects, they typically subcontract installation activities to the building and construction industry. Their most typical subcontractors will be HVAC and lighting contractors. As a result, ESCO staff does not normally include the type of site-based installation personnel that the building and construction contractors do. Reflecting this situation, the US energy efficiency services workforce study by Goldman et al (2010) found that the staff of US ESCOs is roughly 60 percent engineers.[258]

[256]Stewart et al, 2013, op. cit.
[257]Stewart et al, 2013, op. cit.
[258]Goldman et al, 2010, op. cit.

Types of US ESCOs and listing of specific US ESCOs: As mentioned, historically, the early ESCO industry in the US was composed mostly of small, entrepreneurial companies ("independent ESCOs") and a few subsidiaries of utilities. Eventually, the manufacturers of energy efficient equipment joined the sector as a means of promoting their equipment and, in the process, leveraging their nationwide network of offices.[259]

These same three types of ESCOs (independent, utility subsidiary, and equipment vendor) still exist today, though there has been consolidation in the industry with acquisition by larger companies of the independent ESCOs. There has also been entry of a few new types of ESCOs. Harris Williams & Co., an investment bank, in a 2010 whitepaper on ESCOs, includes the original three types of companies in the current-day ESCO market and adds a fourth. Their ESCO typologies are: (1) independent ESCOs, (2) building equipment manufacturers, (3) utility companies, and (4) E&C (engineering and construction) companies.[260] Navigant Consulting, in their 2015 report on the US ESCO industry, similarly refer to: (1) independent ESCOs, (2) building technology provider ESCO business units, and (3) utility ESCOs. Instead of E&C companies, Navigant lists (4) engineering services firms. And, they add a fifth category of (5) private sector intermediaries.[261] Some of these key types of ESCOs are discussed further, later in this subsection.

Exhibit 2-2: Key US ESCO Industry Players by Type of Company

Building Technology Provider ESCO Business Units	Utility Subsidiary ESCOs	
Honeywell Johnson Controls Schneider Electric Siemens Trane United Technologies (NORESCO)†	ConEdison Solutions Constellation Energy Energy Systems Group NextEra Energy (Florida Power and Light) Pepco Energy Services	
Engineering Services Firms	**Independent ESCOs**	**Private Sector Intermediaries**
AECOM Lockheed Martin McKinstry[262]	Ameresco	Metrus Energy Noesis SCIenergy

Sources: Categories and all listed companies except United Technologies are from Navigant Consulting, *Energy Services Company Market Overview*, 2015, accessed via summary of report in Oct. 2015 at https://www.navigantresearch.com/research/energy-service-company-market-overview.

†United Technologies raised as an example in Harris Williams & Co. white paper *ESCOs*: – *Enabling Energy Efficiency: An Introduction to Energy Service Companies ("ESCOs")*, 2010.

To give an idea of who the larger players in these categories in the US market are, Navigant's 2015 listing of key ESCO industry players is included in Exhibit 2-2. The Navigant list in Exhibit 2-2 is supplemented with additional key ESCOs mentioned by Harris Williams & Co. Industry consolidation is significant, with key industry players playing a substantial role in

[259]Interview with Donald Gilligan, Oct. 2015, op. cit.

[260]Harris Williams & Co. white paper: *ESCOs – Enabling Energy Efficiency: An Introduction to Energy Service Companies ("ESCOs")*, 2010.

[261]Navigant Consulting, *Energy Services Company Market Overview*, 2015, accessed via summary of report in Oct. 2015 at https://www.navigantresearch.com/research/energy-service-company-market-overview .

[262]Interestingly, McKinstry on its website indicates: "McKinstry is one of 16 energy service companies (ESCOs) awarded an indefinite-delivery, indefinite-quantity (IDIQ) Department of Energy (DOE) energy savings performance contracts (ESPCs)." http://www.mckinstry.com/capabilities/energy/Federal .

the industry. Of 45 ESCOs total in the US, the 13 that each had annual revenues over US100 million in 2011 accounted for 85 percent of the ESCO market that year.[263] Stewart et al (2013) have noted the trend of larger ESCOs acquiring smaller ones. Further, the fact that Harris Williams & Co., an investment bank, has issued an ESCO white paper implies ESCOs are of significant interest to those involved in the mergers and acquisitions business.

An additional listing of US ESCOs, this one based on those accredited by the US ESCO association NAESCO, is given in Exhibit 2-3. Discussion of the accreditation program is given later in this section.

Exhibit 2-3: US ESCO Companies Accredited by the US ESCO Association, NAESCO

Energy Service Provider (ESP) Accreditation* Note: Definition of ESP is different than that used in this report		
AMERESCO	Energy Systems Group	OpTerra Energy Services
ConEdison Solutions	Johnson Controls, Inc.	Pepco Energy Services, Inc.
Constellation	NORESCO	Siemens Industry, Inc.
ESCO Accreditation**		
ABM Building and Energy Solutions	Energy Solutions Professionals, LLC	NextEra Energy Solutions
AECOM	Harshaw Trane	Performance Services, Inc.
Climatec BTG	Honeywell International Inc.	Schneider Electric
Control Technology and Solutions (CTS)	Lockheed Martin	Trane
	McClure Company	Wendel Energy Services
Energy Efficiency Contractor (EEC) Accreditation**		
Energy Focus	Retro-Tech Systems	

*For ESP accreditation all requirements of the ESCO accreditation must be met and, in addition, requirements for energy supply services must be met.
**ESCO accreditation requirements cover five technology categories (lighting, motors and drives, HVAC systems, control systems, and building envelope improvements) and seven functional requirements (energy audits, design engineering, providing or arranging project financing, construction management, commissioning, operation and maintenance of energy efficiency technologies, and verification of energy savings).
***EEC accreditation requires capabilities in at least one energy efficiency measure (such as lighting) or one type of service (such as project management). EECs may offer multiple measures and services. According to NAESCO, EECs typically work as subcontractors to ESCOs or ESPs.
Source: NAESCO website accessed in Oct. 2015: http://www.naesco.org/accreditation .

Independent ESCOs: The independent ESCOs are not owned by any parent company, such as an electric or gas utility, equipment/controls manufacturer, or energy supply company. Harris Williams & Co., in their ESCO white paper, note that these companies tend to be either regional or end-market focused. They further indicate that the majority of independent ESCOs in the US have been acquired by the three other categories of ESCO they list: the building equipment manufacturers, the utilities, and the engineering and construction firms.[264] Interestingly, Navigant's listing of key US ESCOs (see Exhibit 2-2) includes only one independent ESCO suggesting either this trend of acquisition or that the independent ESCOs have mostly remained small. The one key ESCO that remains independent is Ameresco, the largest independent ESCO in the country.

[263]Stewart et al, 2013, op. cit.
[264]Harris Williams & Co., 2010, op. cit.

Building equipment manufacturers: Building equipment manufacturers have been increasing their share of the US ESCO project market via acquisitions of independent ESCOs and by leveraging synergies of their existing businesses and large sales networks. For example, they may bundle energy efficiency services with facility management services in offering a package deal to their clients.[265]

Utility companies: The number of utility-owned ESCOs has varied based on market trends. Harris Williams & Co. note that the number of utility-owned ESCOs dropped from 19 in 2000 to only seven in 2006, as utilities went from seeing an ESCO as a competitive advantage (a way to attract clients) to deciding to focus on their core business again. Yet, with increasing emphasis on clean and efficient energy, the number of utility ESCOs is again increasing.[266]

Engineering and construction companies: More recent entrants to the US ESCO market, engineering and construction companies have been attracted by the opportunity to diversify service offerings and benefit from the push for efficiency.[267]

Profitability and growth US ESCO sector: Sources indicate that the US ESCO sector has been growing at times at a much faster pace than the US economy generally. (For example, Stewart et al, 2013, find this when looking at the years 2009 to 2011.) Investment bank Harris Williams & Co. (writing in 2010 with an interest in ESCO mergers and acquisitions) note that "ESCOs are realizing substantial profit growth and generating sizable returns for shareholders."

Accreditation of US ESCOs: The US ESCO Association, NAESCO, runs an accreditation scheme for ESCOs. For companies that apply, a committee of experts unaffiliated with any particular ESCO or company under consideration for accreditation examines the applicant company's core competencies and business practices and consults with customers for references. NAESCO has three accreditation categories: ESP, ESCO, and EEC. The ESP category is different from that used in this paper. In order to receive NAESCO's "ESP" accreditation, companies are required, in addition to meeting ESCO accreditation requirements, to offer energy supply services. The ESCO category aligns with the definition used in this paper. "ESCO" accreditation requires that the company demonstrates capability in the following five technology categories: lighting, motors and drives, HVAC systems, control systems, and building envelope improvements. The company must also demonstrate capability in the full range of services required for ESCO projects including: energy audits, design engineering, providing or arranging project financing, construction management, commissioning, operation and maintenance of energy efficiency technologies, and verification of energy savings. In order to receive NAESCO "EEC" ("energy efficiency contractor") accreditation, companies are required to offer some but not all ESCO services. Currently, 14 companies hold the NAESCO ESCO accreditation, nine hold its ESP

[265]Harris Williams & Co., 2010, op. cit.
[266]Harris Williams & Co., 2010, op. cit.
[267]Harris Williams & Co., 2010, op. cit.

accreditation, and two hold its EEC accreditation.[268] These companies are listed in Exhibit 2-3.

Profile of largest independent US ESCO - Ameresco: Ameresco, founded in 2000, is the US's largest independent ESCO and one of the largest players in the overall market. Its 2011 revenues were reported to be USD728 million, a substantial share of the overall ESCO market, which at that time was estimated by LBL to be USD5.3 billion. Ameresco has over 900 employees across the US including about 200 in the state of Massachusetts. Most of its revenues are from its energy efficiency unit. The business model is fairly simple: Ameresco audits its potential client's energy consumption, recommends ways to cut use, and, if the project goes forward, secures loans from a third-party lender to finance retrofits. While energy efficiency is the main business, due to demand, Ameresco has expanded into renewable energy projects, which, in 2012, accounted for 25 percent of revenue. The majority of its clients are government agencies and nonprofit institutions, such as universities and hospitals. These often can't afford the high up-front costs of multi-million dollar energy efficiency projects, so benefit from the ESCO business model. An example of a major Ameresco client is the Boston Housing Authority (BHA). An agreement for USD63 million was signed between Ameresco and BHA to cover 13 facilities across the city of Boston. BHA pays back the loan gradually, but Ameresco does not get paid until energy savings are verified. Ameresco claims an average annual energy savings of 35 percent per project across its clients, though the US ESCO average is thought to be closer to 20 percent.[269]

2.1.4 US ESP Market and Companies (General)

Efforts at sizing the US ESP market and workforce: Sizing the entire US ESP market is much more difficult than sizing the subset of that market consisting of ESCOs. Across sources, there is an emphasis on the difficulty of defining the scope of the US ESP market and thus on the difficulty of estimating ESP market size. As mentioned, one study has estimated the US ESP workforce of 2008 at 114,000 person-years, of which about one-tenth is accounted for by ESCOs. The same study estimated 2008 ESP revenues at USD18 billion, as compared to USD3 billion, indicated in another study, for ESCOs. This suggests ESCOs may represent only about one-sixth of the overall US ESP market.[270]

Nature of non-ESCO ESP companies: Overall, ESP companies in the US might be divided into two groups, those that are focused mainly on providing energy efficiency services and those that do not see energy efficiency as their man business, but provide it as a part of a broader portfolio of services. Goldman et al (2010), in their study of the energy efficiency services workforce, find that most firms providing energy efficiency services as their main areas of business are quite small – often under ten persons, though there are a few very large firms. Looking at surveys for specific states, they found that energy efficiency focused companies tend to include a large number of small consulting firms and startups and a very limited number of large engineering firms and ESCOs. They found that over 75 percent of

[268]NAESCO website: http://www.naesco.org/accreditation, accessed in October 2015.
[269] Information in this paragraph is based on Fitzgerald, 2012, op. cit.
[270]Goldman et al, 2010, op. cit. and Satchwell et al, 2010, op. cit. (the latter for US ESCO market size in 2008).

energy efficiency focused firms surveyed had 100 or fewer persons and 34 percent had ten or fewer persons.[271]

Among those companies that do not have energy efficiency as their core business, but see it as a business line or service offering, are design and engineering firms, equipment providers, architects, electricians, mechanical contractors, insulation contractors, and other building and construction industry companies. Goldman et al (2010) point out that, in order to promote energy efficiency solutions widely, the focus should not only be on the energy efficiency focused companies, but also on providing these broader scope companies with energy efficiency training. In discussing the energy efficiency services sector (EESS), the authors explain that, "At present, it does not constitute an independent industry, since the activities of the EESS, rather than being new efforts, typically consist of a shift from standard practice to a more energy efficient approach to the design, construction, equipping, and operating of buildings."[272]

Policy and ESPs: As with the ESCO industry in particular, policy, and especially policy manifested as financial incentives, is an important driver of the ESP industry. Goldman et al (2010) in their workforce study find that the energy efficiency services business as they define it has about 30 percent of its person-years of work generated by utility rate-funded energy efficiency programs. This base includes those employed by the government to administer the programs, the contractors that implement projects under the programs, and building and construction professionals and trade people that design and install the projects. Goldman et al further state that building codes and standards have been a major contributor to energy efficiency investments, perhaps resulting in about half of the person-years of work they estimate, and mainly carried out by persons in the building and construction industry.[273]

2.2 US Industrial ESCO Market

This subsection focuses on the US industrial ESCO market, which is the subset of the US industrial ESP market consisting of companies that use performance-based contracting as one of the main ways they do business. ESCO activity in the US industrial sector turns out to be relatively limited. The next subsection (subsection w.3) delves into the broader industrial ESP market in general, where it appears non-ESCO models and fee-for-service providers are predominant.

US industrial ESCO market: As noted, 2011 data presented by Stewart et al (2013), indicates that together the commercial building and industrial customer segment of the US ESCO market is 8.1 percent of the total US ESCO market. With an estimate of USD5.263 billion for the full market in 2011, this implies an annual commercial and industrial market of USD426 million that year. Data was not available on the breakdown between commercial buildings and industrial customers, nor was it available on the types of measures instituted for industrial clients. A general impression, however, is that commercial building opportunities

[271]Goldman et al, 2010, op. cit.
[272]Goldman et al, 2010, op. cit.
[273]Goldman et al, 2010, op. cit.

are seen to have more potential in the future and that the performance-based ESCO work that is occurring in the industrial sector tends to be focused on building measures or CHP rather than on aspects more directly tied to manufacturing and processes. Indeed, the two clearest examples of industrial ESCO projects found in the literature focus on building retrofits.

As for CHP and other forms of energy supply, a source at NAESCO (the US ESCO association) has explained that energy supply power purchase agreements (PPAs) are the one situation in which ESCOs are active in the industrial sector.[274] This corresponds with an increased demand among industrial companies for "resilience", or independence from the power grid to alleviate problems associated with grid outages.[275] According to an earlier study in 2002, a number of utility-affiliated ESCOs targeted the industrial market, hoping to leverage preexisting relationships with customers. The most successful was CINergy Solutions, which partnered with Trigen Energy Corporation. CINergy appears to be an example of an energy supply focused ESCO, having offered comprehensive energy solutions to clients, including energy procurement, onsite generation, and other services such as water, wastewater, and solid waste services. A number of other ESCOs (non-utility ones) tried to follow this model, but with only limited success.[276]

Reasons for lack of ESCOs in US industrial sector: While the industrial sector was initially the focus of the US ESCO industry, there are now several reasons why the ESCO model no longer works well for US industry. In summary, these reasons are: (1) US industry faces tough global competition and needs to be flexible to change rapidly. Therefore, industry does not like to sign the long-term contracts (e.g. in the range of five to ten years) that may be needed for ESCO projects. (2) The building technologies on which ESCOs focus are no longer new and inaccessible. Many industrial clients would rather cut costs by buying the technologies themselves and retrofitting piecemeal than hire an ESCO (with an ESCO margin) to do a comprehensive project. (3) ESCOs are generalists and focus on buildings and do not have the capabilities to support industry in its largest energy consuming areas, such as industrial processes and cross-cutting industrial equipment serving those processes. (4) US industry is focused on its core business and is more likely to hire those providers with whom it is already working on its core business to add supplementary energy efficiency support than to hire ESCOs. (5) US industry may be hesitant to let outsiders inside its facilities due to preferences for secrecy. Thus, again, trusted service providers with whom they already work on other aspects of their business may be better placed to provide energy efficiency support. (6) It is more difficult to measure energy savings in industry than in buildings, due to the complex mix of industrial processes and cross-cutting equipment, so that the performance based model is hard to implement in areas that constitute the bulk of industrial energy use.

History of ESCOs in industry: As mentioned, in the late 80s and early 90s, as the US ESCO industry grew, the best customers were industrial users. This is because they have relatively long operational hours, thus resulting in higher savings for installed equipment. There was also a wave of new technologies in lighting and motors; and utilities were paying quite high

[274]Interview with Donald Gilligan, Oct. 2015, op. cit.
[275]Interview with John Smegal, US Department of Energy, October 2015. Mr. Smegal pointed out the trend of resilience that is stimulating greater demand for on-site power provision among industrial customers.
[276]Neal Elliot, *Vendors as Industrial Energy Service Providers*, American Council for an Energy Efficient Economy, 2002.

prices for these to be installed in industry. These early ESCO projects in industry were largely building measures – lighting and controls. Projects were typically shared savings in which the ESCO took both the financial risk and the technical risk (that the equipment would work). At the time, since the utility was the payer, no credit risk analysis of the factory was required. As mentioned previously, these early contracts were based on payment for energy avoided and were very lucrative for the ESCOs. Once the utilities stopped paying so much and eventually began subsidizing only a part of the equipment costs, the end users were required to pay a good portion of costs. Industrial customers were not interested in that.[277]

Elaborations on reasons for lack of ESCOs in US industry: The economic environment for US industry has gotten much harsher since the early ESCO days. Thus, industrial clients are not interested in any kind of long-term deal, because of the precarious condition they are in. Even those industrial facilities owned by large companies don't know the future fate of their specific facility. Thus, industrial clients are not willing to sign a five to ten year loan with an ESCO, as there is a constant threat of factory closure. While China has a thriving industrial sector ESCO market (as will be covered later in this report), this may be related to the nature of Chinese industry. In China, there is still much "low-hanging fruit" in industrial energy efficiency, so that paybacks can be quite fast – sometimes less than a year. In the US, such "low-hanging fruit" has already been picked. And, the longer paybacks are no longer attractive to US industry.[278]

Industrial customers, even if not worried about their longevity, are unlikely to invest in long payback period energy efficiency projects for another reason. Once the payback periods become long, energy efficiency must compete with other potential long-term investment projects. And, the investment plans related to the industrial firm's core business are much more likely to be selected.[279]

Further, the "magic" of the basic building technologies that ESCOs provide has disappeared. Initially hard to access, these technologies, such as CFLs, are now easily purchased by all. Industrial customers, accustomed to buying in bulk, are sophisticated buyers. They prefer to handle purchases on their own and push suppliers for low prices. Installing building related energy efficiency equipment is also not that difficult for them. Thus, industry makes a much less attractive client than, say, an institutional building client, which would like help in its purchases and in carrying out a comprehensive project. The institutional building client is willing to pay a premium for the ESCO to bring the different parts of the project together and appreciates the upfront financing provided. The industrial client, in contrast, prefers to buy the equipment themselves and conduct the retrofits in a piecemeal fashion. The institutional client (e.g. a school or government building) is also a better credit risk for the ESCO, as it is more certain to be around for many years.[280]

Another issue is that ESCOs don't have industry-specialized expertise. They can't afford to staff up with experts in different industries as it does not fit their cross-sector business model.

[277]This paragraph is based on input from interview with Donald Gilligan, Oct. 2015, op. cit.
[278]Interview with Donald Gilligan, Oct. 2015, op. cit.
[279]Interview with Donald Gilligan, Oct. 2015, op. cit.
[280]Interview with Donald Gilligan, Oct. 2015, op. cit.

If they were able to have sector specific expertise on the other hand, this might bode better for ESCOs approaching the industrial market. As it is, with ESCOs' building expertise only, industrial customers don't see the ESCOs as having anything they can't handle on their own.[281] Further, since most of the energy use in industry is not the buildings, building focused ESCOs will have limited impact in the industrial sector, even if they could attract industrial customers. In addition, industry presents the downside challenge to potential ESCO providers that the non-building energy efficiency efforts may be more difficult to replicate from customer to customer.[282]

Cases of energy efficiency ESCO projects in US industrial sector: While limited, there are examples of recent ESCO projects in the industrial sector, as presented below.

General Motors (GM) case: As a part of its participation in the US Department of Energy Better Plants Program, the well-known multi-national GM has recently implemented a series of ESCO energy performance contracts. Since 2012, GM has carried out over USD40 million in energy performance contracting with ESCO partners. The GM case is a rare example of extensive EPC in US industry. Indeed, in order to achieve internal consensus (which is often a barrier), GM spent several years working up to actually taking action. So far, based on its analysis, GM has selected to use operating lease contracts for all of its ESCO projects. Contrary to the typical definition of ESCO in which the ESCO takes on performance risk, with operating lease contracts, such as GM has used, the customer takes on all the performance risk. Yet, there is little or no down payment required on the part of the customer and this appears to have been the main attraction to GM, which wishes to keep its capital free for other, core business priorities. Although the Better Plants Program targets 25 percent reductions across all plants and all energy uses of industrial partners, GM's ESCO projects so far appear to be all building focused and not involving industrial processes or cross-cutting equipment supporting those processes.[283]

Company named "ESCO": Despite reports that ESCOs are finding little opportunity in the US industrial sector, a company that has adopted the company name "ESCO" appears to have done numerous projects for industrial clients. "ESCO" is focused on lighting projects and serves manufacturing, education, healthcare, government, garage, industrial warehouse, and office clients. "ESCO" lists an extremely impressive 85 industrial clients on its website, including a number of Fortune 500 companies, such as MeadWestvaco, International Paper, Dana Corporation, TRW, and United Technologies (the last of which, incidentally has its own ESCO). In a testimonial by RR Donnelly, which produces printed packaging and other printed materials, RR Donnelly company management discuss how they were attracted to utilize an energy savings program offered by their utility, Connecticut Power and Light, and engaged "ESCO" to do a lighting retrofit project for them. They had been having "rework" problems, whereby product would have to be redone due to employees not seeing well in poor lighting. Thus, the project had not only an energy-saving benefit, but also a productivity

[281] For the first part of this paragraph: Interview with Donald Gilligan, Oct. 2015, op. cit.
[282] For the second part of this paragraph: Neal Elliot, 2002, op. cit.
[283] Details on the GM case are taken from information provided by the US Department of Energy and accessed in Oct. 2015 at http://betterbuildingssolutioncenter.energy.gov/implementation-models/energy-performance-contracting. Information on the Better Plants program is based on personal communications with Andre deFontaine of the US Department of Energy in November, 2015.

benefit. RR Donnelly management expressed great satisfaction for the results of the project and in particular the improved lighting of the factory.[284] Yet, it's not clear from available materials whether "ESCO's" many industrial lighting projects have been performance based and thus represent true ESCO projects.

2.3 Industrial ESP Market in the US

In this subsection, we first cover general findings on ESPs in the US industrial market and then discuss the situation of small US industrial companies and ESPs. While the first part of the subsection is meant to address ESPs in the industrial sector in general, it applies most aptly to larger industrial facilities or at least those owned by larger companies. Several sources indicate that small industrial companies in the US do not often retain energy efficiency service providers, aside from those supported through a government program providing energy audits to them for free. At the same time, small companies may have preferred service providers for updating and repairing equipment, who could potentially be a relevant channel for energy efficiency improvements in the future. At present, however, larger industrial companies and facilities are the main ones to retain ESPs for specific energy efficiency purposes, aside from those small industrial companies benefiting from government-sponsored energy audits in their facilities.

2.3.1 General Findings on ESPs in US Industrial Market

Nature of industrial ESPs, reasons for predominance of non-ESCOs, and business models of industrial ESPs in the US: According to sources, instead of ESCOs, which are not that active in the industrial energy efficiency sector in the US, engineering firms and equipment vendors play the greatest role in providing energy efficiency services to industrial clients. Clients that purchase these services are generally believed to be larger industrial facilities or large industrial companies that have the resources to do so. The engineering firms include both large ones and small ones. Qualified individual specialists may also play a role. Some very small engineering firms may be quite specialized in a single aspect of industrial energy use. One source mentioned, as an example, a small engineering firm of eight to ten people that focuses on a specific type of heat transfer at refineries and travels around the country to provide its service to various refinery end users, helping them to save energy in this way. In addition to engineering firms and equipment vendors, there are also specialized construction firms serving industry, including on aspects related to energy efficiency. These firms may not be quite as specialized as some of the engineering firms, but may specialize in a certain type of equipment, such as a hot air system or compressed air. They are complementary in the value chain to the engineering firms, which will design the work that is then contracted out to the construction firm.[285] Sources indicate that energy efficiency

[284] This paragraph is based on information on "ESCO's" website accessed in October 2015 at http://goesco.com . Information on clients is at http://goesco.com/clients/ . And the RR Donnelly video testimonial is at http://goesco.com/client-testimonials/ .
[285]Preceding sentences in this paragraph are based on interview with Donald Gilligan, Oct. 2015, op. cit.

services provided by engineering firms are generally-fee based. Further, some large industrial facilities may depend mostly on in-house energy efficiency personnel.[286]

In 2002, the American Council for an Energy Efficient Economy (ACEEE) did an extensive study of the question of why ESCOs are not seen in the industrial sector and what types of organizations are doing energy efficiency work for industry instead. Findings pointed to engineering firms and equipment vendors as the key ESPs serving industry. The author, Neal Elliott, found that engineering firms and equipment vendors have a number of advantages over ESCOs including: (1) industrial expertise, (2) intimate knowledge of plant and processes, (3) their work not being perceived as an energy project, and (4) access to decision makers. Because they are perceived as experts with knowledge of the plant and its processes, they can better target their projects to the plants' needs. ESCOs, in contrast, are considered experts on energy generally, but not on the specifics of the client and its industrial sector. ESCOs may also be perceived as deal makers with expertise in finance. In addition, as compared to ESCOs, based on ongoing relationships, engineering firms and equipment vendors generally have better access to decision makers. They may be likely to be dealing with corporate management for other services they provide, so have a level of access that ESCOs will not have. In terms of previous relationships with clients, Elliott found that often engineering firms have a deal with their industrial customers whereby they serve as the facility engineering department. In terms of "not being perceived as an energy project," Elliott references previous studies that have shown industrial energy efficiency projects are most often undertaken for their non-energy benefits. The projects generally originate from within the client organization and may be focused on increasing productivity, safety, or other benefits, while achieving improved energy efficiency on the side.[287]

Types of Projects and Business Models of Non-ESCO ESPs in the US Industrial Sector: In terms of types of projects that (non-ESCO) ESPs provide to industrial sector clients, sources suggest that all major industrial energy use areas (industrial processes, cross-cutting equipment serving those processes, and industrial buildings) are addressed. Overall, the most common type of ES- provided project identified in research for this report was for cross-cutting equipment serving industrial processes (e.g. process heating systems, compressed air systems, electric motor systems, and fans and pumping systems). This may be because, as mentioned earlier, building measures may be simpler and easier for the industrial customer to handle themselves on a piecemeal basis. Further, industrial processes may be quite specific to certain customers. Indeed, for one US Government industrial energy efficiency program, it was noticed that outside consultants help provide general support in setting up energy management systems, but that energy savings, including those in industrial processes, are most often found by in-house staff who know the processes best.[288]

[286]Interview with John Smegal, Oct. 2015, op. cit. Mr. Smegal provided input on the fee-based nature of ESPs in industry as well as the existence of in-house energy efficiency personnel. Referencing experience with US DOE's SEP Program, Paul Scheihing of US Department of Energy (US DOE), in communications with the author in Nov. 2015, indicates they have found a mix of outside and internal energy efficiency experts used in the industrial facilities of the companies they partner with.
[287] Discussion in this paragraph is based on Neal Elliott, 2002, op. cit.
[288] Communication with Paul Sheihing, Nov. 2015, op. cit.

The US Environmental Protection Agency (US EPA), in a program for industrial energy efficiency, lists "industrial service and product providers" ("ISPPs") that have partnered with US industry to achieve energy efficiency improvements for the program. They categorize these ISPPs by the following areas: air handling unit, architecture/engineering, automation/controls, compressed air, energy assessment/ energy project implementation, HVAC, metering, lighting, motors/lubricating products, refrigeration, steam/hot water, solar, and water treatment.[289] This list, then, suggests demand for both cross-cutting equipment expertise and building energy efficiency expertise in the US industrial sector.

The US Department of Energy, which has developed software tools in certain areas relevant to industrial energy efficiency, maintains a list of qualified specialists that can help clients utilize DOE software tools and identify ways to improve energy system efficiency and help optimize process heating, steam, pumps, fans, and compressed air systems. The specialists conduct three-day assessments at industrial facilities and are classified into the following areas, which are all cross-cutting equipment areas supporting industrial processes: process heating, steam system, pumping system, fan system, and compressed air system.[290] The specialists are listed as individuals rather than companies, suggesting a role for individual contractors in these areas, though some may be affiliated with companies. The emphasis on cross-cutting equipment serving industrial processes implies this segment as a key area in which outside ESPs can support industrial customers.

Elliott, in his 2002 study of industrial ESPs, reviews the situation and services of both equipment vendors and engineering firms. He finds the equipment vendor business model for ESP services is to sell value-added services with equipment. And, this model at its best may include services that are ongoing. Examples of ongoing services identified include services for boilers, compressed air systems, and motors. For boilers, the service may be water treatment for boilers and may also include system tune-ups and controls. To provide this service, the vendor comes in periodically to test the water and adjust the chemicals as needed. These periodic visits allow the vendor to build a long-term relationship with the customer.[291]

A similar business model among vendors of compressed air systems is to provide associated services, including system optimization, end-use measures, maintenance, and controls. In some cases, the customer may outsource compressed air service entirely to the vendor. According to Elliott (2002), the linking of services to equipment sales in the compressed air industry has proven so cost-effective for the industry that nearly all providers in the sector have adopted this approach.[292]

A similar business model is used in some parts of the motor equipment industry. In this case, the motor equipment vendor will sell related services and ancillary equipment (e.g. controls

[289] The US EPA ISPP provider list was accessed on the EPA website under their Industrial Energy Management Program at https://www.energystar.gov/buildings/facility-owners-and-managers/industrial-plants/industrial-service-and-product-providers in Oct. 2015.
[290] The US Department of Energy listings of industrial energy efficiency specialists that can assist with DOE software and assessment in cross-cutting equipment areas were accessed online in Oct. 2015 at http://www.energy.gov/eere/amo/downloads/qualified-specialists-industrial-assessment-tools .
[291] Discussion in this paragraph is based on Neal Elliott, 2002, op. cit.
[292] Discussion in this paragraph is based on Neal Elliott, 2002, op. cit.

and sensors) that increase functionality of the motor system. Specific measures include condition-based motor monitoring to improve reliability, installation of variable-speed drives, and smart control systems to optimize productivity. Some involved companies offer financing for the equipment purchase, installation, and servicing of their products. Further, via remote monitoring and control, the equipment vendor can play an even more active role in operation of the equipment. As with the previous two examples, the ongoing relationship better positions the vendor for sale of additional services.[293]

Elliott notes that some of the frontrunners in the business model of combining services and equipment sales are national manufacturers of a broad range of industrial products. He mentions Emerson as an example of a company that has restructured and made strategic acquisitions to create greater marketing synergies among product areas, including motors, drives, controls, and automation systems. Equipment manufacturers may also increase direct sales (as compared to agent/distributor sales) to implement this equipment-and-service model. Elliott also observes trends of increased bundling at the local level, such as motor service shops offering more value-added services.[294]

The business model of the engineering firm ESPs is, in contrast, project focused. The engineering firm may be initially retained to design a process line or oversee installation of a major piece of equipment. Because they develop familiarity with the technical details of the plant and have the opportunity to be onsite, they can identify additional projects. And, their expertise as perceived by the client, as well as their familiarity with the specific plant, allows them to make strong proposals for these additional projects. In his 2002 study, Elliott found that some engineering firms were even building alliances with financial services companies that would allow them to aggregate projects (offer a number of projects together) on attractive financial terms. He found that they were generally developing the ability to design, build, finance, and operate, perhaps similar to the ESCO model, but with deeper technical expertise in the industrial sector.[295] Yet, in research for this report, over ten years later, sources indicate that engineering firms are still operating mostly on a fee-for-service basis in the area of industrial energy efficiency.

At the same time, the two main categories of ESPs serving industry (equipment vendors and engineering firms) face some challenges in terms of providing energy efficiency services. Equipment vendors, generally large national firms, have financial strength. Yet, because they are selling equipment, their recommendations as service providers may be seen as biased in favor of selling equipment rather than in the best interest of their customers. As for engineering firms, they are traditionally seen as designers of systems only. If they are to expand their work to implementation, they may face challenges with financing and operations. Both types of providers may need to be trained in energy efficiency related areas and/or expand staffing to address energy efficiency issues.[296] Indeed, for a nation that is trying to enhance industrial energy efficiency, such as Turkey, reaching out to such providers

[293] Discussion in this paragraph is based on Neal Elliott, 2002, op. cit.
[294] Discussion in this paragraph is based on Neal Elliott, 2002, op. cit.
[295] Discussion in this paragraph is based on Neal Elliott, 2002, op. cit.
[296] Discussion in preceding sentences in this paragraph based on Neal Elliot, 2002, op. cit.

and ensuring they are knowledgeable and trained in adding energy efficiency services to their repertoire may be a strategy to consider.

Exhibit 2-4: Areas of Industrial Energy Service with Potential for Outsourcing
As mentioned by interviewees of the 2014 ACEEE Study *Outsourcing Energy Performance: Its Potential for Industrial Energy Efficiency Programs*
Note: When vendors were mentioned, they are included in parentheses and italics

Distributed Generation	**Powerhouse Prime Movers and Support**	**Space Conditioning and Comfort**
-Combined heat and power (*Recycled Energy Development, NRG Energy*) -District energy applications, including steam, hot water, chilled water (*Hot Zero, Recycled Energy Development*)	-Boilers using fossil fuel (*Johnson Controls, Springfield Mechanical*) -Boilers using renewable or onsite "opportunity" fuel -Standby generation -Boilers as CHP backup -Cooling towers (*NALCO, Johnson Controls*) -Steam distribution system optimization (*TLV*)	-Lighting asset installation and maintenance -Heating/ventilation/air conditioning (*Johnson Controls, Honeywell, Jones Lang Salle*) -Chillers -Data center cooling (*Johnson Controls*) -Control room HVAC
Materials Refrigeration and Heating Space Conditioning	**Water Treatment**	**Process Air and Airborne Particulate Handling**
- Geocoupled thermal networking; integrating process heating/cooling loads (*Geoscart*)	-Water and wastewater -Descaling (steel mills)	-Fans and fan systems -Ventilation
Electric Power Quality and Maintenance	**Motor Drivers**	**Solar**
- Power infrastructure	-Compressed air (*Kaeser, Air Masters, Atlas Copco*) -Any motor-based technology	-Photovoltaics
Industrial Gases	**Non-Specified**	
-Onsite provision of gas feedstocks	-Any non-core technology -Any technology with low regulatory/ permit risk	

Source: Christopher Russell, *Outsourcing Energy Performance: Its Potential for Industrial Energy Efficiency Programs*, American Council for an Energy Efficient Economy, 2014.

Elliott concludes that the business model used by these two groups, offering energy efficiency services in conjunction with other products or services (i.e. equipment or engineering services), appears viable. The model leverages existing relationships with decision makers at the industrial client. He further suggests that outsourcing of energy services, whereby an industrial facility transfers responsibility for one or more energy functions (such as steam, compressed air, water treatment, lighting, or other activities) to a service provider may be a growing trend.[297] Yet, in an ACEEE study written over ten years later (2014) by Christopher Russell on the topic, it is indicated that the trend of outsourcing of energy sources is still limited. The 2014 study indicates there are isolated examples; and outsourcing of energy services is a viable model for which there is some demand, but may require stimulation to take off. Exhibit 2-4 lists the areas of industrial energy services mentioned by interviewees in the 2014 ACEEE study as having potential for outsourcing.

[297] Preceding sentences of this paragraph based on Neal Elliott, 2002, op. cit.

Russell distinguishes between energy services outsourcing and energy performance contracting used by ESCOs. He notes that the former is an ongoing relationship, whereas close involvement of the ESCO in the case of EPC ceases once the system is stabilized. Energy outsourcing contracts can be performance based, thus fitting this report's definition of ESCO project. Yet, Russell notes that due to the high cost of vendor-provided capital, a model of ESPs as implementation and operation contractors rather than providers of capital is more common.[298] While the energy services outsourcing model has not come to full fruition in the US, it still may be a model for Turkey to consider as it looks to develop its industrial energy efficiency services sector.

Drivers of Non-ESCO industrial ESP business: As mentioned above, many energy efficiency measures achieved via ESPs may actually be done through projects pursued for other objectives, such as productivity. Yet, Goldman (2010) has noted that within the US, ISO50001, an energy management system standard that establishes a comprehensive framework for industrial plants, facilities, and organizations to manage energy, promises to be a major driver of industrial energy efficiency and thus of services for industrial energy efficiency. He notes that previous ISO standards (ISO9000 and ISO14001) were adopted rapidly by industry in the US, so that the same could be expected of ISO50001. Further, the US Department of Energy (DOE), through its programs in partnering with large industrial companies who voluntarily target savings, is expected to be a substantial driver. Finally, while a trend for outsourcing services in industry generally has been noted as a potential driver for greater opportunities for industrial ESPs, it is still unclear whether the outsourcing trend will flourish with regard to energy services in particular.

Issue of industrial processes: Industrial processes, responsible for the majority of industrial energy consumption in the US, are an important area in which to address energy efficiency. As indicated, some sources suggest that consultants specialized by specific industrial sector are needed to improve industrial process efficiency. Some examples have been cited. On the other hand, other sources suggest that the processes are known best by internal staff. For example, a DOE official noted his observation that in a DOE partnership with large industrial users, outside providers work with companies to implement energy management systems. The energy saving opportunities found are usually operational improvements around key processes or significant energy uses and not large capital projects. These energy savings opportunities are usually found by in-house staff, who are the ones most familiar with industrial processes.[299] Another source emphasizes that, when there are long payback periods, improvements in industrial processes can't compete with other investment opportunities. He suggests that, indeed, the most cost-effective approach is to ensure that when new equipment is purchased and new lines are set up, they are the most efficient possible.[300]

Certification of non-ESCO industrial ESPs: The US Department of Energy (US DOE) has developed certification programs related to energy efficiency providers to industry. Through their Superior Energy Performance (SEP) Program for industry, they have developed three

[298]Discussion in preceding sentences of the second part of this paragraph based on Christopher Russell, *Outsourcing Energy Performance: Its Potential for Industrial Energy Efficiency Programs*, American Council for an Energy Efficient Economy, 2014.
[299]Communications with Paul Scheihing, Nov. 2015, op. cit.
[300] Interview with Donald Gilligan, Oct. 2015, op. cit.

levels of certification. One (at the lowest level) is that of Certified Practitioners in Energy Management Systems (CP EnMS). These practitioners can help industrial facilities set up energy management systems. There are now about 100 persons who have achieved DOE's Certified Practitioner in Energy Management status. These may be solo consultants, work for consulting firms, or be in-house energy mangers of industrial companies. DOE has also developed certification for "Lead Evaluators" and "Performance Verifiers", though there are many fewer persons certified in these areas.[301]

Listing and profiles of US (Non-ESCO) Industrial ESPs: To provide further insights on industrial ESPs in the US, this section provides a US Environmental Protection Agency (EPA) listing of some such ESPs and brief profiles of the four of them that are indicated to have completed more than one project with industrial customers through the EPA program.

EPA list of ESPs by area: As mentioned earlier, EPA provides a list of industrial ESPs relevant to energy efficiency (which they call "Industrial Service and Product Providers") by area of specialization. The list of providers is given in Exhibit 2-5 by service area. The list also indicates the industrial client companies that the providers have worked with through the EPA's industrial energy efficiency program.

Profile of Cascade Energy Engineering: Cascade Energy was founded in 1993 by two professional engineers and another partner. It is headquartered in Portland, Oregon, USA, and has offices in four other states as well. The company is an engineering consulting firm focused on industrial energy efficiency. This contrasts somewhat with the trend expressed by sources that most providers of energy efficiency services to industry may not have energy efficiency as their primary focus. Cascade provides its services to corporations and utilities and has twenty years of experience as a company. Systems that Cascade works on include: chillers, cooling towers, and HVAC; compressed air; controls and variable frequency drives; fans, pumps, and blowers; lighting; manufacturing processes; refrigeration; and thermal systems. They work across a range of industries, including: agriculture, chemicals, food processing, high technology, manufacturing, mining and primary metals, oil and gas, pulp and paper and wood products, refrigerated storage and distribution, and water and wastewater. Under the EPA program, Cascade conducted two projects in the category of energy assessment/ energy project implementation, one for JR Simplot and one for ConAgra. Cascades services for corporations include capital projects, carbon tracking and reporting, education and coaching, energy certification, energy monitoring, facility tune-ups, and incentives and grants. A program they provide is "strategic energy management." They also have utility clients whom they help with efficiency programs. Services for the utilities include: customer engagement programs, behavior-based programs, demand-side management, and trade ally programs. Industrial case studies they provide of their work show savings of USD51,000 in annual energy cost savings (42 percent reduction) at a cold storage company (where the company was the direct client) and USD185,000 annual energy savings per year (35 percent reduction in energy use) for a fruit processing company via measures in refrigeration, compressed air, door, and lighting upgrades.[302] Interestingly, both these cases,

[301] Interview with John Smegal, Oct. 2015, op. cit.
[302] Cascade Energy's website is source of information for this profile. Accessed in November 2015, the website is https://cascadeenergy.com/ .

in terms of annual energy use, may fit the definition of small and medium scale industrial facility used by the US Government SME audit program. These cases suggest that at least a subset of such facilities are willing to retain an ESP to help reduce energy consumption.

Exhibit 2-5: US EPA Listed Industrial ESPs by Area of Work, also Showing Clients they Have Served via the EPA's Industrial Energy Efficiency Program

Area	ESP	Clients via EPA Program
Air Handling Unit	-F.E. Moran Mechanical Services, Inc.	-PepsiCo
Architecture/ Engineering	-The Benham Companies -DomeTech -Johnson Controls -PSI -PS&S -Sebesta Blomberg -Siemens Building Technologies	-Ford Motor Company -Merck & Company -Ford Motor Company -Ford Motor Company -Johnson & Johnson -3M -Ford Motor Company
Automation/Controls	-Rockwell Automation	-General Mills -Owens Corning
Compressed Air	-Accurate Air Engineering, Inc. -Bay Controls, LLC -Gardner Denver -Solution Dynamics, LLC -Kaeser Compressors, Inc. -Pneu-Logic Corporation	-Kraft Foods -Ford Motor Company -McCain Foods USA -AGCO -CEMEX -Pepsi Co., Gatorade
Energy Assessments/ Energy Project Implementation	-Balance Engineering -Cascade Energy Engineering -DomeTech -DTE Energy -F L Smidth Inc. -NOVI Energy, LLC -Optimira Energy, Inc. -Prenova -Yates Services, LLC	-Eli Lilly and Company -JR Simplot Company -ConAgra Lamb Weston -Schering-Plough -Ford Motor Company -Titan Florida Cement -Honeywell -Subaru -Owens Corning -Nissan North America
HVAC	-NALCO Company -Koch Filter Corporation	-Nissan North America, Inc. -DOW Chemical
Lighting	-New England Energy Management -Varo Engineers, Inc. -Pearl Street LED Lighting Systems -Wheatstone -SDI eBusiness (RelightDepot) -Aleux -E4E Solutions, LLC	-Ford Motor Company -Owns Corning -Merck & Co. -Frito-Lay -Navistar International -Dresser Inc. -Alcoa
Metering	-Centro, Inc.	-Nissan
Motors/ Lubricating Products	-Baldor Electric Company -Southwestern Petroleum Corporation	-PepsiCo/Frito Lay -Intertape Polymer Group
Refrigeration	-tekWorx	-Schering-Plough
Steam/Hot Water	-Armstrong International	-Pfizer -Pepsi Americas
Solar	-DomeTech	-Merck
Water Treatment	-ChemTreat, Inc.	-Eastman Chemical Co.

Source: US EPA website, accessed in October 2015 at https://www.energystar.gov/buildings/facility-owners-and-managers/industrial-plants/industrial-service-and-product-providers/ispp .

Profile of DomeTech: DomeTech is a subsidiary of NORESCO (an ESCO), which is a subsidiary of Carrier, which is a subsidiary of United Technologies Power. Officially, DomeTech was acquired in 2007 by United Technologies. More recent reports, however, indicate that the brand name "DomeTech" will be retired and the brand "NORESCO" will be used instead for its services. DomeTech's work appears to be very building focused and cuts across both industrial and non-industrial customers. DomeTech provides energy engineering and consulting services to existing buildings and new constructions. Thus, despite some indications that industrial customers are less interested in outside providers of building energy efficiency, the case of DomeTech (like the case of lighting specialist "ESCO" and the case of GM presented in the section on ESCOs in the industrial sector) suggests that exceptions to these indications may be substantial. Perhaps the payment model of ESCOs, rather than the building focus, is the bigger barrier to ESCO activities in the industrial sector. DomeTech services include sustainable building consulting/ energy modeling, new and existing building commissioning, building turnover services, energy procurement consulting, benchmarking and conservation opportunities, energy and field performance testing, retro-commissioning, operation and maintenance, project implementation, energy audits, and renewable energy consulting. The scope of clients is broad. Within industry, pharmaceutical and manufacturing are areas of work, but the company also serves higher education, schools, and the commercial real estate sectors. Founded in 1989, the company is based in New Jersey, USA, with offices in two other nearby states.[303] Under the EPA industrial energy efficiency program, DomeTech carried out projects in three different areas: (1) architecture /engineering (for Merck), (2) energy assessments/ energy project implementation (for Schering Plough), and (3) solar energy (for Merck).

Profile of Rockwell Automation: Rockwell Automation is an industrial ESP of the equipment vendor variety. It is headquartered in Wisconsin, USA. The company reported USD6.35 billion in sales in 2013. It employs 22,000 people and has customers in over 80 countries. One of Rockwell's main brands is Allen Bradley (AB) industrial control equipment. Equipment such as variable speed drives, motors, and PLCs (programmable logic controllers) are key products of the AB brand. Rockwell's industrial control equipment is sold across many industrial sectors, such as pulp and paper, forest products, iron and steel, other metals, oil and gas, chemicals, ports and airports, water and wastewater, and other manufacturing sectors. Under the EPA industrial energy efficiency program, Rockwell conducted two projects in the automation/controls area, one for General Mills and one for Owens Corning. In addition to its products, Rockwell offers many solutions and services, including "process solutions," suggesting that it may be an ESP that can tap into the important area of improving clients' industrial process energy efficiency.[304]

Profile of Armstrong: Armstrong is a private, family-owned company with about 3,000 employees working in the areas of steam, air, and hot water. It is an equipment vendor that provides services in conjunction with the equipment it sells. Armstrong's clients include industrial and non-industrial entities, with sectors of focus being higher education, healthcare,

[303]Bloomberg website is source of information on DomeTech, accessed in November 2015 at http://www.bloomberg.com/research/stocks/private/snapshot.asp?privcapId=33494292 .
[304]Some information taken from Rockwell website http://www.rockwellautomation.com/ accessed in Nov. 2015.

hospitality, refineries, food and beverage, pharmaceuticals, and power. The products and systems it provides include steam and condensate, hot water, humidification, refrigeration, flow measurement, and heat transfer products (coils). Its optimization services include: operations and maintenance, energy audits, utility system engineering, project management and turkey systems, project financing, asset ownership, steam trap management, and water solutions for hydraulic fracturing (a method of extracting natural gas from rock).[305] Under the EPA industrial energy efficiency program, Armstrong carried out two projects, both in the area of steam hot water, one for Pfizer and one for Pepsi America.

Implications of findings and recommended approaches for strengthening industrial ESPs: Findings on ESPs in the US industrial sector have implications for strengthening industrial ESPs, both in the US and other countries. For example, given that there may be specialized engineering firms that serve industrial clients in certain sectors, but that know less about energy efficiency, there may be an opportunity to influence industry by training these specialized engineering firms and encouraging them to expand their scope of services to include energy efficiency. Further, ESPs that focus in certain areas of cross-cutting industrial equipment that serve industrial processes may be an important group to foster. For example, these may include companies that focus on compressed air, on motors, or on boilers. In general, training on energy efficiency for vendors and engineering firms that already serve industry may be a strategy to consider, with providers serving specific industrial sectors being one angle of overall focus and those focusing on certain types of cross-cutting equipment being another. In addition, while it has been suggested that building focused ESCOs are not attractive to industrial customers, there is evidence of third parties providing building energy efficiency services to industry. This finding suggests that there is still room for building focused ESPs in industry, but that they may require a model different than performance contracting. Because industrial processes vary from sector to sector, for process-focused energy efficiency improvements, programs to promote ESPs, as suggested, may need to take a sector based approach. At the same time, the importance of in-house personal in identifying energy efficiency improvements, particularly in industrial processes, should not be underestimated. One alternative model to consider is outside third parties (who work across industrial sectors) coming into facilities to provide energy management system support and working closely with in-house staff who may then be the ones to identify savings opportunities. Finally, outsourcing of energy services (where the contactor is responsible for ensuring the smooth, ongoing delivery of a particular energy service) may be an important model to consider and promote in the future. While this model may have some similarities to the ESCO model if carried out on a performance basis, it may be more likely that industrial customers prefer traditional fee-for-service arrangements.

3.3.2 US Small Industrial Companies and Use of ESPs

General situation of SME industrial companies and ESP use: Interviews conducted for this study suggest that small and medium sized industrial facilities in the US are not very likely to retain outside consultants and other types of ESPs to help them improve energy efficiency. At the same time, some possible exceptions were identified, suggesting further

[305]Information about Armstrong sourced from company website at https://www.armstronginternational.com/ in Nov. 2015.

research may be needed on this topic.[306] Sources suggest that, unlike the larger firms that may have the resources to retain such consultants or that may have in-house staff focused on energy management, the smaller industrial companies lack the resources to retain outside help or hire energy-specialized staff. Thus, the distinction between a small facility of a large company and a facility of small company may be important. The provision of ESP services to SME industrial companies may be a gap in the US that is in most cases being met only by government programs that subsidize support. Among such programs, probably the most substantial is the Industrial Assessment Center (IAC) Program of the US Department of Energy. The IAC Program model may be one that Turkey wishes to consider. At the same time, small and medium-sized manufacturing facilities may be likely to hire a third party (a vendor or service provider) to update or repair a piece of equipment. These third parties are relied upon to install the proper size and type of equipment. They may be another potential conduit for promoting energy efficiency to SME industrial facilities. As such, government programs may wish to ensure this type of third party organization is aware of energy efficient equipment and energy efficient repair issues.[307]

While the IAC Program will be covered from the angle of government policy and programs later in this section, findings about IAC will be presented here as a means of offering insights on the nature of the clients, the nature of projects, and other issues related to ESP work in the US SME industrial sector. The 24 centers under the IAC program, which are all located at universities, can be considered among the key ESPs operating in the US SME industrial sector. Under the program, the centers send teams of students led by an advisor to industrial facilities where they provide audits. The audits are provided free to the SMEs and include a one-day site visit. On average, each IAC conducts 25 SME industrial energy audits per year.

In an interview with one of the IACs, it was mentioned that it is the IAC rather than the industrial facilities that do the initial outreach to connect the two parties. The IAC may use a directory of manufacturing facilities in its state and cold-call potential customers to ask if they would be interested in a free audit. This shows that the customers are not proactively seeking out energy efficiency services. Yet, they often respond positively; and implementation rates of audit recommendations are substantial.[308]

One question that arises is whether there are other ESPs actively providing services to SME industrial plants that are paid for by the plants themselves. Interviewees suggest this is not commonly the case, though, as mentioned, exceptions are apparent. In fact, a recent (2015) third-party evaluation of the IAC program found that IAC audits did not overlap with the market served by non-government programs.[309] One interviewee mentioned his experience that SME industrial firms in the US rarely hire outside providers for energy efficiency. He finds the exception to this is that SME industrial facilities may sometimes hire super-

[306]These include case studies provided on its website by Cascade, the industrial energy efficiency consulting firm profiled earlier in this report.
[307]The topic of hiring of third parties for repair or updating of equipment as an energy efficiency opportunity is raised in Anna Monis Shipley et al, *Energy Efficiency Programs for Small and Medium Sized Industry*, American Council for an Energy Efficient Economy, 2002.
[308]Interview with James Eggebrecht, Assistant Director, Texas A&M Industrial Assessment Center, October, 2015.
[309]SRI International, *Saving Energy, Building Skills: Industrial Assessment Centers Impact*, 2015.

specialists in a certain type of equipment, such as a fan specialist.[310] Another source mentioned that the ESPs in the market (such as energy consulting firms and ESCOs) in fact are quite appreciative of the IAC Program in that it does not conflict with their market, but provides workforce training via which they can find qualified graduates to enter their firms.[311] At the same time, as discussed later in this section, equipment manufacturers may provide implementation support to small and medium sized industrial clients for more difficult aspects of implementing IAC audit recommendations. So, in this regard, they may also be considered ESPs serving the SME industrial sector.

Typical SME industrial clients: The criteria for participation in the IAC program to receive a free industrial energy audit gives some idea of the typical SME industrial client. The program requires that the clients are industrial firms, located within 150 miles of a participating university. They further require that the specific facility have fewer than 500 employees at the plant site, have annual energy bills of between USD100,000 and USD2.5 million, and have no professional in-house staff to perform the energy assessment. Revenues associated with the facility should be under USD100 million, though in practice according to the Texas A&M Center's findings, facility-associated revenues of USD10 to 20 million, staff of 80 to 300 people, and annual utility bills of USD150,000 to USD500,000 are most typical. Typical annual energy use is 55 million BTUs natural gas equivalent. The revenue criteria is plant by plant, so that plants of larger companies may qualify for the program. In fact, in Texas it has been found that plants that are out of range (too large) are a small minority. In general, these factories are not high tech facilities with clean rooms. Instead, in the case of Texas case for example, it has been observed that they usually do not have air conditioning (Texas is quite hot in the summer); and some facilities may actually be open air on one side (i.e. without four walls).[312] The IAC program keeps an extensive database of audits and follow up conducted since 1981. Review of this database by industrial sector shows in which sectors the most audits have been conducted, thus also giving a view of the SME industrial "market" for these government-supported audits. Results of such a review are offered in Exhibit 2-6.

2-6: Top Types of US SME Industrial Facility Clients by Sector that Have Received Energy Audits since 1981 via the IAC Program

Industry Classification (NAICS)*	Number of Facilities Assessed	Industry Classification (NAIC)	Number of Facilities Assessed
Fabricated Metal Product Manufacturing	797	Chemicals Manufacturing	413
Food Manufacturing	727	Primary Metal Manufacturing	380
Plastic and Rubber Product Manufacturing	599	Wood Product Manufacturing	291
Machinery Manufacturing	489	Paper Manufacturing	281
Transportation Equipment Manufacturing	484	Non-metallic Mineral Product Manufacturing	218

Source: IAC database; NAIC stands for "Northern American Industrial Classification System," which is a system of classifying different types of industries. It is commonly used in the US.

[310] Interview with James Eggebrecht, Oct. 2015, op. cit.
[311] Interview with John Smegal, Oct. 2015, op. cit.
[312] Interview with James Eggebrecht, Oct. 2015, op. cit.

Typical areas of ESP service and implementation for small industrial companies and facilities: If indeed small and medium sized industrial companies (and facilities) do not often proactively hire ESPs, the most common ESP services may be those provided by government programs. And, the most extensive program in this regard is the IAC program, which provides audits. Thus, the most common ESP service for the SME industrial sector may be energy audits. In terms of specific types of recommendations made in the IAC audits, these have been categorized by area. Data exists on the number of different facilities in which a particular type of recommendation has been, as well as on the implementation rate. Major categories of recommendation area are (1) Energy Management, (2) Water Minimization/ Pollution, and (3) Direct Productivity Enhancements. Sub-recommendation areas and "sub-sub" areas for the Energy Management Category are given in Exhibit 2-7. The number of factories having received recommendations in the relevant area and the implementation rate of recommendations in the area are also given.

Exhibit 2-7: Energy Management Sub-Areas of Recommendations, Number of Times Recommended, and Implementation Rates --- IAC Audits from 1981 to Present

Note: Numbers for categories in bold are aggregate of sub-categories below them.
Note: In addition to (1) "Energy Management," assessments also cover (2) "Water Minimization/ Pollution Prevention," and (3) "Direct Productivity Enhancements," but these areas are not included in this table.

Area	No. of Facilities	Implementation Rate	Area	No. of Facilities	Implementation Rate
Combustion Systems	**7,242**	**47%**	**Motor Systems**	**37,905**	**57%**
Furnaces, Ovens, Direct Fired	1,387	47%	Motors	13,560	53%
Boilers	3,887	57%	Air Compressors	21,314	60%
Fuel switching	1,968	28%	Other Equipment	3,029	44%
Thermal Systems	**16,957**	**42%**	**Industrial Design**	**477**	**35%**
Steam	3,687	64%	Systems	477	35%
Heating	246	50%	**Operations**	**5,892**	**54%**
Heat Treating	91	21%	Maintenance	537	66%
Heat Recovery	6,418	28%	Equipment Control	5,355	53%
Heat Containment	4,884	46%	**Building and Grounds**	**37,689**	**49%**
Cooling	1,569	32%	Lighting	26,636	51%
Drying	62	43%	Space Conditioning	7,225	44%
Electrical Power	**5,326**	**36%**	Ventilation	821	43%
Demand Management	2,674	39%	Building Envelope	3,007	45%
Power Factor	1,970	38%	**Ancillary Costs**	**2,559**	**52%**
Generation of Power	75	27%	Administrative	2,467	53%
Cogeneration	472	11%	Shipping, Distr., Transport	92	34%
Transmission	135	30%	**Alternative Energy**	**251**	**7%**
			General	251	7%

Source: IAC Database (entries made for 1981 up until Nov. 2015).

Considering the three broad areas of industrial energy use ((1) processes, (2) cross-cutting equipment serving processes, and (3) building) and based on discussion with one of the IACs, it appears that the IAC audit recommendations focus on the cross-cutting equipment and building areas, with the greatest emphasis on cross-cutting equipment. The recommendations do not cover much in the area of industrial processes. The site visits are only one day, whereas process improvement would take a much longer time of observation and testing. For buildings (in the case of the Texas IAC), the main focus is on the lights, as most of the facilities do not have air conditioning. For cross-cutting equipment, examples of typical

recommendation areas include compressed air, steam, loss of heat to insulation, and steam traps that are leaking.[313]

The recommendations made in the audits and the high adoption rates raise the question of whether ESPs are the ones implementing the recommendations. Based on the Texas A&M IAC's experience, most of the recommendations of the IAC audits that are implemented are done so by the plants' internal staff, rather than outside ESPs. Recommendations such as repairing air leaks and changing lights are something that plant maintenance personnel can handle. More complicated aspects, depending on the expertise of internal staff, may either be handled by such staff or by equipment vendors for motors, boilers, etc. If the plant is a part of a larger corporation, which might have a corporate staff person to help, such corporate internal experts may assist. Most facilities, according to sources, are too small to afford outside help from ESCO-type or pure engineering consulting type organizations. Also, in general, these types of organizations will not typically have more experience with the equipment than the vendors themselves.[314]

Focusing on cross-cutting areas for SME industrial clients reduces costs, given relatively strong replicability of measurements and actions, and is what most government programs in this area do. SME industrial clients as a group may be less energy-intensive in their processes than certain large industrial clients, so that focus on cross-cutting supporting aspects rather than industrial processes themselves makes sense. At the same time, sources agree that addressing process energy use in SME industrial clients is currently a largely unaddressed area in the US. One means where some initial progress in addressing this area may already have occurred is with government manufacturing assistance programs for SME industrial clients. Such programs may advocate methods such as "lean manufacturing." Their services, provided at low cost to clients, may have them on site over a much longer period of time than the one-day IAC assessments, with a focus on productivity. Thus, incorporating energy efficiency in industrial processes into their service scope could be a strategic entry point.

Another method some government industrial energy efficiency programs have used in the US is to focus on specific industrial sectors of SMEs. The programs may develop training for SMEs in a certain sector and develop initiatives to help them as a group improve industrial process efficiency. An interesting example of this has occurred in the US state of Wisconsin, where a non-profit organization (Energy Center of Wisconsin, ECW) has partnered with Wisconsin Manufacturing Extension Partnership (WMEP). WMEP is a fee-based service provider whose activities are subsidized, and who provides manufacturing specialists to help industry improve productivity, profitability, and competitiveness. ECW in this work has targeted metal casting and metal finishing industries as having the greatest potential energy savings. Ninety percent of the enterprises in this sector have less than 100 employees in Wisconsin. The program focuses on general competitiveness, for which energy efficiency is considered part of the solution.[315]

[313] Interview with James Eggebrecht, Oct. 2015, op. cit.
[314]Interview with James Eggebrecht, Oct. 2015, op. cit.
[315]Information on the Wisconsin example is taken from Anna Monis Shipley et al, 2002, op. cit.

As with large industrial enterprises, a key area for industrial energy efficiency improvement in SMEs is in the setting up of new production lines or purchase of new equipment. These are considered key opportunities, as the associated payback can be much more attractive than that of upgrading an existing line. The problem is that, as with large industrial enterprises, there is as of yet not a systematic way for reaching out to SMEs to ensure these new lines and purchases are as energy efficient as possible. As SMEs do retain third parties to repair and upgrade equipment, these third parties may be an important channel to reach out to so as to ensure incorporation of energy efficiency analysis into initial purchases.[316]

Implication of findings and recommended approaches for small industrial companies: Some key findings on ESPs in the US small and medium sized enterprise industrial sector and their implications are as follows: First, SME industrial enterprises may have different behavior than large enterprises in their retaining of ESPs. Thus, separate strategies for SME and large company industrial ESP enhancement may be needed. Second, government programs play an important role in this sector, as SMEs are hesitant to retain expensive third party consultants. In particular, a government funded audit program (free or partially subsidized audits) can be an effective means if it is designed to achieve a high level of implementation of audit recommendations, as the IAC program has achieved. At the same time, the gap in terms of addressing industrial process energy efficiency in SMEs calls for an additional approach focused on processes. An effort targeted at SME industrial processes might be incorporated into general manufacturing assistance programs, such as through enhancing lean manufacturing guidance with energy efficiency aspects. Further, government SME programs may focus on clusters of enterprises in certain industrial sectors or sub-sectors, so as to address the energy efficiency of their processes. Another potential channel to note for both processes and cross-cutting equipment are the third parties that SME industrial facilities may depend on for equipment repair and updating, whether these be vendors or service-only providers. A strategy may be to train these parties on energy efficiency aspects, so they can incorporate such knowledge into their services to SMEs, both for repairs and new purchases of equipment. Generally, there is a need to access SME decision-making when new lines and new equipment are installed, as these decision points may yield much higher returns than upgrading of existing systems. This access may be achieved via the third-party outreach efforts and/or the sector focused efforts proposed here.

2.4 Government Programs Related to Industrial ESPs in the US

This sub-section covers US government programs related to industrial ESPs. Programs are separated into SME industrial facility focused programs and general (or large) facility focused programs. The most depth is provided on US Department of Energy (DOE) and US Environmental Protection Agency (EPA) programs, though other programs, such as utility programs or state government initiatives, are mentioned and thought to play a role in the sector. Some programs covered are not focused on ESPs, but have some relevance to them. In such cases, the discussion in this report focuses on aspects of those programs that may be relevant to ESP development. Findings discussed so far in this report suggest that equipment

[316]Anna Monis Shipley et al, 2002, op. cit.

vendors and engineering consulting firms serving industrial facilities can be an important conduit for industrial energy efficiency programs to address. Further, for the SME sector, third parties providing services in updating or repairing equipment may be a conduit, though subsidized support may also be needed. Ideally, efforts to promote ESPs in industry will address not only cross cutting equipment measures and building measures (typically the most addressed areas to date) but also process improvements. And ideally, all three of these areas will be covered both for large industrial enterprises and for industrial SMEs.

2.4.1 Government SME Industrial Energy Efficiency Programs in the US

This sub-section reviews government SME industrial energy efficiency programs in the US. Chief among these is US Department of Energy's Industrial Assessment Center (IAC) program. As this program in effect serves as one of the most effective conduits for ESPs in the SME industrial sector, it has been discussed above in terms of market, clients, and projects. In this sub-section, more information will be provided on the program's structure, day-to-day workings, and benefits. Other programs may be implemented at the state or utility level. Further, general manufacturing programs supporting SMEs may be a good channel for addressing the unmet need for energy efficiency improvements in industrial processes. In general, programs (and ESPs for that matter) might focus on cross-cutting areas across industries (such as motors, lights, and compressed air) or focus on the processes of particular industrial segments. The latter tends to be the less-addressed aspect. Both types of programs are needed.

IAC structure, funding, and selection criteria: The US IAC program recently celebrated its 40th anniversary. The program, managed by the US Department of Energy, funds 24 university-based industrial assessment centers. Universities undergo a competitive application process every five years, though some universities have had their center for many years. The centers send teams of students along with one experienced advisor to conduct one-day site visits to audit small industrial facilities. Audits are the main activities of the centers; and they do not get involved in implementation of recommendations. At present, annual funding is USD6 to 7 million. With 24 university-based assessment centers, annual funding of each center is USD200,000 to USD300,000. Altogether, the 24 centers conduct about 600 audits per year, or, on average, 25 audits per center annually. This comes out to USD10,000 per audit. The calculation, however, does not consider training activities and workforce development benefits of the program, which are also part of the USD10,000 per audit "package." That is, the program has two key objectives: (1) increase energy efficiency in the nation's SME industrial enterprises and (2) train the next generation of energy efficiency professionals among today's engineering students.[317]

As has been mentioned, sources believe that the IAC program does not interfere with the market of private sector service providers. Generally, they indicate, small industrial enterprises will not retain outside providers for audits (though exceptions are apparent). When contacted by the universities involved, some small and medium-sized industrial facilities are willing to have an audit conducted on-site that is free to them.

[317] This paragraph is based on interview with John Smegal, Oct. 2015, op. cit.

IAC benefits and results, including implementation rates, replication of program, and other positive indications: IAC implementation rates are relatively high, validating the success and cost-effectiveness of the program. The program has kept a detailed database since 1981 of all recommendations made and implemented. As can be seen from scanning Exhibit 2-7, implementation rates for many categories of measures are in the 40 to 50 percent range. The Texas A&M Center, interviewed for this report, has achieved a 62 percent implementation rate for its recommendations over the years. Whether or not a measure is implemented will depend on cost and also availability of funding at the host company at the time. If new equipment is required (such as for a CHP system), the recommendation may be more difficult to implement. Yet, a lot of items recommended by the audits (such as addressing compressed air leaks) are pretty minimal in funding requirements.[318]

Other indications of the positive results of the program include international interest, repeat customers, and calculated energy savings per dollar invested. Several countries have shown strong interest in learning more about the program for potential replication. China, which earlier interacted with the program, has now developed 50 industrial assessment centers of its own. The DOE industrial energy efficiency team does not have a mandate to spread the program internationally, but the team and program centers tend to be open to providing information and facilitating learning by program developers in other countries, even providing webinars at times. While outreach for new audit clients is usually undertaken proactively by the IAC, it has been found that, when someone who interacted with the program while at one employer moves to a new employer, they will sometimes call the local IAC to request an audit at their new employer. Thus, in a sense, these people become "repeat customers." The phenomenon suggests the program is valued by clients. Finally, a recent third party evaluation of the IAC program conducted by SRI (2015) found that every US dollar invested in the program results in six to eight US dollars of annual energy savings. This estimate does not include savings generated after the first year of implementation and instead only considers one year of energy savings. Earlier studies had come up with a five to six times return on government investment in the form of tax revenues (via lower energy costs and thus increased profits at clients), presumably using multiple years of energy savings to reach this result.[319]

Finally, the work force benefits of the IAC Program are in strong evidence. The SRI study (2015) shows that engineering graduates that have participated in the program are more likely to end up working in energy efficiency related fields than those who have not participated in the program. Further, graduates who have participated in the program are sought after by ESCOs and other employers in energy efficiency related fields. Interestingly, some energy efficiency related job advertisements in the US now require IAC participation. IAC grads have also started their own energy consulting firms (such as Cascade, profiled earlier in this study) and hold key positions in the industry (such as one graduate who is a Vice President for Sustainability at ABB).[320]

[318] Discussion of what determines implementation based on interview with James Eggebrecht, Oct. 2015, op. cit.
[319]Input for this paragraph based on SRI International, 2015, op. cit., interview with James Eggebrecht, Oct. 2015, op. cit., and interview with John Smegal, Oct. 2015, op. cit.
[320]Input for this paragraph based on SRI International, 2015, op. cit., interview with James Eggebrecht, Oct. 2015, op. cit., and interview with John Smegal, Oct. 2015, op. cit.

Day-to-day workings of IAC program[321]: Based on discussion with the Texas A&M IAC, more details of the day-to-day workings of the IAC Program were obtained. These may be useful for parties wishing to replicate the program.

Training aside from the on-the-job assessment training: Training other than that gained through carrying out audits includes the following: (1) Safety training (takes place before a student participates in any site visit). (2) Training on features of audit report and how to prepare it (takes place before any site visit). (3) Training on typical assessment recommendations related to the technologies they see (takes place after the foregoing two trainings). The purpose of this third area of training is to enable students to recognize typical potential recommendations during the site visits and to ensure they know what kind of data to gather for such recommendations. (4) Outside speakers: Some outside persons from equipment vendor companies are brought in to share their expertise with students. (5) Visit to equipment vendor company sites: Sometimes students are taken to vendor company sites, as the companies may have special laboratory equipment for training. One example is a company that allows students to see steam equipment in operation and to see what happens when it breaks down and needs maintenance.

Identification of client SMEs: Most of the time, initial client identification and liaison is handled by the assistant director of the center, who uses a compendium on local manufacturing facilities to identify and contact potential clients.

Composition of team for site visits: Every IAC conducts audits with a team composed of the center director or assistant director and a group of students. The director and assistant director are responsible for the students and their actions. At Texas A&M, they typically go to an assessment site with four to six students. The number is usually five, because that allows them to fit in the mini-van they use for transport.

Assessments per student: Most undergraduate students start with the IAC program later in their second year of college, or sometimes in their third year. They go on two to four assessment site visits each semester. Thus, they typically accumulate between 12-20 visits by the time they graduate. The student team visiting a site consists of the Team Leader and three to four other students. The Team Leader assignment usually comes after a student has been on about three site visits. The Team Leader is the student who is given the utility bills for analysis and presents the analysis to plant management at the time of initial assessment on the day of the site visit. All the students are given assessment recommendations to evaluate during the site visit day, which determine the focus of desk work after return to the university. The projects (of the individual students) are written up with all calculations in detail; and the team leader puts all the write-ups into a coherent report that the director or assistant director reviews. There are usually two to three rounds of edits/reviews before a report is sent to the client. The graduate students come to the IAC program as Master's degree or PhD candidates, and generally participate in a total number of assessments similar to that of the undergraduates.

[321]This section on "day-to-day workings of the IAC program" is based on follow-up communications with James Eggebrecht of Texas A&M University's IAC, October, 2015.

Desk work follow up after the assessment: Many of the recommendations can be evaluated and written up in about an hour. Some take longer, as there may be more talking with vendors or equipment folks needed to find solutions, etc. A student may expect to get roughly two recommendations to evaluate for each visit on average. This number, however, will depend upon the number of team members and what the team finds as far as potential recommendations to evaluate at any particular plant. The assistant director may take a number of hours to review the first draft of the report and a much shorter time for reviewing subsequent drafts. Then later, for each report, they must also call back to the plant sometime in the timeframe of six to nine months after the report was delivered to find out what projects have been implemented. That information is then provided to the IAC database.

Other SME programs: SME programs implemented by other agencies in the US may also be relevant to industrial energy efficiency. Of particular interest, SME manufacturing support programs, under the US Department of Commerce and individual states, may have the potential to address process issues should energy efficiency become a priority for them. Further, utilities may include small and medium sized enterprises in various subsidy and rebate programs. Further, state governments and state-based organizations may have programs addressing energy efficiency. Of note is the program in Wisconsin mentioned earlies that had focused on a particular type of manufacturer (metal casting and metal finishing) in order to be able to address process improvements. One other practice worth noting program-wise is the idea of having SME industrial facilities share an energy manager among multiple companies.

2.4.2 Government General Industrial Energy Efficiency Programs in the US – Mainly Targeting Larger Companies

This sub-section will review general government programs in the US for promoting industrial energy efficiency. It will not cover programs specifically focused on SMEs, as these were covered in the last sub-section. The emphasis of the review will be on those aspects of the programs that are relevant to ESPs. In general, ESPs are not the main or sole purpose of these programs, but the programs provide opportunities for ESPs and thus cultivate an environment in which ESPs can develop. In some cases, a program may have specific activities or initiatives for cultivating ESPs. The main programs covered are those at the national level, including two programs carried out by the US Department of Energy (DOE) and one program carried out by the US Environmental Protection Agency (EPA). A general trend among these programs is that they offer companies both free technical assistance and the opportunity to be recognized as environmentally responsible in return for companies committing to a voluntary reduction in energy use. Of these three programs, the EPA one specifically encourages and recognizes partnering between the industrial companies and ESPs. And, one of the DOE programs (SEP) has a specific workforce development initiative for credentialing persons in energy management systems, who may then provide services to industrial participants. In addition to these federal governments programs, one of the most significant types of energy efficiency program involving industry may be those run by the utilities. As discussed in reviewing industrial energy efficiency in the US in general, utilities may be required by their regulators to carry out demand side management programs, in which they offer incentives or technical assistance to clients to reduce energy usage. While these programs are generally not

specific to industrial clients, industrial clients may be included in the scope of those utility customers invited to participate.

Previous US Government industrial energy efficiency programs appear to share characteristics with present ones in terms of use of ESPs. For example, DOE's previous LEADERS Program (which has now transformed into the "Better Plants" program discussed below) conducted over 3,000 energy assessments in industrial plants over a period of two years.[322] These included system-specific assessments in the areas of steam, process heating, compressed air, pumping, and fan systems. The assessments lasted three days and were provided either for free to the industrial client or with cost-sharing. The assessments were conducted by DOE-identified Qualified Energy Experts.[323] This experience provides a model for fostering ESPs and bringing them together with customers through a program that provides free or low-cost audits. Also, part of the model is that the audits look at several specific systems commonly found in industry.

EPA Program and Partnering between ESPs and Industrial Clients: The United States Environmental Protection Agency (EPA) has a program promoting industrial energy management. They first offer industrial companies general guidelines on a setting up an energy management system. EPA then provides industrial companies the opportunity to become "Energy STAR Partners" with EPA by signing a partnership agreement. Service and product providers ("SPPs") can also sign a (different type of) Energy STAR agreement with the EPA. EPA defines this second group as "organizations that provide energy efficiency services and/or products to commercial buildings and industrial manufacturing plants in the United States, including architects, distributors, energy consultant/energy management services companies, energy improvement contractors, energy information services, energy services companies, engineering, equipment manufacturers, financial services companies, on-site energy production services, and unregulated energy retailers and marketers."[324] EPA designates a specific partnership category and type of partnership agreement for SPPs that work with ENERGY STAR industrial sector partners to implement energy efficiency projects. To qualify, an SPP much have completed an energy efficiency project within the last two years for a client who is an ENERGY STAR industrial partner in good standing and complete a "teaming profile" about the experience. SPP's may be motivated to join the program to enhance their credibility and customer base. They can use the "ENERGY STAR" logo and will also be listed as an industrial service or product provider ("ISPP") on the EPA's website. In order for industrial SPP partners to continue to be listed, they need to complete reporting on new projects and teaming profiles every two years. The EPA also recommends that the ISPPs use EPA guidelines for energy management in carrying out their work. EPA even provides a guide to ISPP partners for marketing via the use of their ENERGY STAR affiliation.[325]

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[322]American Council on an Energy Efficient Economy, "Update on Save Energy Now LEADER," 2011, accessed in Nov. 2015 at https://www.ase.org/resources/doe-updates-save-energy-now-leader .

[323]Lynn Price, presentation on *Industrial Energy Assessments*, the Second US-China Energy Efficiency Forum, 2011.

[324]EPA website accessed in Nov. 2015 at https://www.energystar.gov/buildings/about-us/become-energy-star-partner .

[325]US EPA, "Partnership Requirements: ENERGY STAR Partnership for Commercial & Industrial Service and Product Providers (SPP)", accessed on USEPA website in Nov. 2015 at:

A table of the EPA's partner industrial service and product providers (ISPPs) is found earlier in this study in Exhibit 2-5. Further, profiles of four of these providers (two engineering firms and two product firms) is provided in the same subsection, which is subsection 2.3.1, "General Findings on ESPs in the US Industrial Sector."

The EPA provides information on both sector-specific measures for energy efficiency and measures for cross-cutting supporting equipment. Preparation of such information appears to be contracted out to other organizations. As for sector-specific information, the EPA provides (or in some cases is planning to provide) industrial energy efficiency information by industrial sector for the following industries: aluminum, brewing, cement, chemical, corn refining, food processing, glass, metal casting, motor vehicle manufacturing, petrochemical, petroleum, refining, pharmaceuticals, pulp and paper, ready mix concrete, steel and iron, and textiles. Many of the sector specific materials are prepared by the US DOE lab Lawrence Berkeley Laboratory (LBL). The University of Utrecht in the Netherlands also appears to be a contractor for this work. Cross-cutting areas in which the EPA provides industrial energy efficiency information include: plant utility and process improvement, compressed air, motors, process heating, pumping, steam, and software tools.[326]

US DOE SEP Program and EMS Certified ESPs: Aside from its IAC Program, which is focused on SME facilities and has already been discussed, US DOE currently has two other major programs to promote industrial energy efficiency via technical assistance. The Superior Energy Performance (SEP) Program is an energy management focused program. Industrial companies that participate voluntarily agree to cut energy use and work to achieve ISO50001, as well more advanced energy management measures associated with the SEP Program. In return, they are able to promote themselves as having achieved these standards and receive free technical assistance. Initially, of about 50 facilities that have started to implement SEP (some of which have already achieved SEP certification), almost all participated in DOE-funded training with expert energy management trainers at Georgia Tech, a US university. Yet, DOE realized that this approach would not be scalable, once increasing numbers of facilities get involved. Thus, they decided to develop a workforce program with professional credentialing. Of the credentials created, the most important is the Certified Practitioner in Energy Management Systems (CP EnMS). For the CP EnMS certification, work experience, education, and an exam are required. Developers of this program saw the need for it, as most existing programs tended to easily certify people mainly on the basis of having attended a training course. The CP EnMS is a person who has the skills to implement SEP, which involves implementing the ISO 50001 energy management system as well as the additional SEP requirements. Therefore, a CP EnMS understands the energy management system processes, as well as energy engineering. US DOE is finding that the successful CP EnMS candidates have mostly been energy management consultants. Yet, recently, even the industrial end users are seeing the value of getting their internal staff to obtain CP EnMS. As mentioned earlier, when external consultants are hired by industrial companies participating

https://www.energystar.gov/sites/default/files/buildings/tools/Partnership%20Requirements%20ENERGY%20STAR%20Partnership%20for%20Commercial%20%26%20Industrial%20Service%20and%20Product%20Providers%20%28SPP%29.pdf .

[326]Various pages of USEPA website under the industrial energy management page, accessed in Oct. 2015 at http://www.energystar.gov/buildings/facility-owners-and-managers/industrial-plants .

in the SEP Program to help achieve SEP requirements, these external consultants tend to focus on implementing the overall structure of the ISO50001 standard and SEP program. Yet, their work may stimulate internal staff of the client to identify energy saving opportunities in industrial processes and other areas.[327]

Better Factories Program: The Better Factories Program is a US DOE program whereby industrial partners voluntarily pledge to target a 25 percent energy use reduction across all their US manufacturing operations, including both process-related energy and building-related energy. The benefit to the industrial partners is that they can market their achievements as a part of this program and can received free technical assistances sponsored by DOE. While a lot of the work is done in-house, the partner companies have been seen to work with engineering firms and equipment vendors to achieve program targets. This work is apart from the free technical assistance provided by the program. For the free assistance, the DOE entity Oak Ridge National Lab (ORNL) is the main provider. ORNL mainly uses its own employees for this work, though it also retains subcontractors, which are mainly small energy efficiency/energy management consulting firms. Finally, the DOE also provides free training to its industrial partners. DOE utilizes a range of trainers, usually DOE qualified specialists that are also posted on DOE's website.[328]

[327]Content of this paragraph based on insights gained from personal communication with Paul Scheihing, Nov. 2015, op. cit. and interview with John Smegal, Oct. 2015, op. cit.
[328]Content of this paragraph is based on insights gained from personal communication with Andre deFontaine, Nov. 2015, op. cit.

3. China Case

3.1 China ESP and ESCO Market

As with the US case, the ESP market for China is here defined as the broader market for energy efficiency related services, whether provided for a fixed fee or via performance-based contracting. The China ESCO market is here defined as a subset of the China ESP market. It is that share of the ESP market consisting of business carried out by performance-based contracts.

Data on the size of China's ESCO market as defined above will be presented later in this section. It is important to note, however, that some have questioned the quality of the available data. That data suggests the China ESCO market was valued at USD12 billion in 2013, substantially surpassing the US's, valued at USD7.6 billion that year, in size.[329] Sources from the same year and just a few years earlier present a view incongruous with these numbers. For example, Kostka and Shin, writing in 2011, say, "China's energy-service companies (ESCOs) have developed only modestly despite favorable political and market conditions…. Despite all of the potential, ESCOs have remained largely a marginal player in delivering energy efficiency goals in China. Some even claim Chinese ESCOs are a case of market failure with a limited ability to implement energy efficiency at a large scale."[330] Ding Ma, writing in 2013, notes: "Despite the huge potential and favoring policies, there are strong opinions from researchers that ESCOs' diffusion in China is far from reaching its potential and large amount of cost-effective investment opportunities are unexploited."[331]

While the available data on China ESCO market size references EPC (energy performance contracting) revenues specifically, some confusion in market size may be related to vagueness in the type of work that qualifies as EPC. While the US ESCO market figures presented earlier in this study are based on revenues of just 45 "true ESCOs," the China ESCO market data accessed for this report assumes a pool of over 2,000 Chinese ESCOs. Kostka and Shin provide evidence from interviews to elucidate the true nature of the Chinese ESCO market. One expert suggested to them (in 2011) that there were perhaps ten real ESCOs in China at the time (when the official numbers suggested there were over 2,000 ESCOs). Another expert suggested to them that Chinese ESCOs are not true ESCOs. He explained that ESCOs are supposed to come up with a unique solution for clients, but that most Chinese ESCOs are merely selling a product that they manufacture. Kostka and Shin go on to note, "Most observers believe the majority of these [officially listed ESCOs] are 'phantom' companies, merely taking advantage of the ESCO status to receive financial and tax benefits that were introduced in 2010 to promote the ESCO industry." Finally, they offer

[329]Meredydd Evans et al, *White Paper: Unleashing Energy Efficiency Retrofits through Energy Performance Contracts in China and the United States*, Pacific Northwest Laboratory and Lawrence Berkeley National Laboratory, April 2015.
[330]Genia Kostka (Frankfurt School) and Kyoung Shin (MIT), *Energy Service Companies in China: The Role of Social Networks and Trust*, Frankfurt School Working Paper Series, No. 168, June 2011.
[331]Ding Ma, *Energy Service Companies (ESCOs) in China: Barriers and Drivers from ESCOs' Perspective*, Master's Thesis, Aalto University School of Business (Finland), 2013.

further quotes from various industry expert and industry insider interviews in 2011, including: "These ESCOs know almost nothing about energy performance contracts." "Seventy to 80 percent have never done ESCO-related work." "Everyone is called an ESCO."[332] Finally, Meredydd Evans et al (2015) note, "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."[333] Given these comments, it might be that much of what is classified as ESCO business in China is more similar to non-ESCO ESP business. Non-performance based vendor financing of equipment purchases may be one common model used. As such, while much of the information presented below will be on the "China ESCO market" in name, there may be some blurring of the boundaries between ESCO and non-ESCO ESP business.

3.1.1 China ESP and ESCO Markets Overall

China energy efficiency market and share of ESCOs in that market: While estimation of the scale of China's entire ESP market is difficult, sources suggest that the market is substantially larger than the estimates of the ESCO market. Evans et al (2015) suggest the Chinese ESCO market in 2013 was 18 percent of the overall energy efficiency market, implying a China ESP market size (including both services and equipment) of USD67 billion, as compared to their China ESCO market estimate (performance-based contracts only) of USD12 billion. This substantial ESCO project market share within the overall ESP market, according to Evans et al, has risen from a five percent share in 2006 to 2010. The authors also provide data on all revenues achieved by Chinese ESCOs in 2013: These were USD36 billion, suggesting that performance based contracts (USD12 billion in 2013) are about a third of all business conducted by "ESCOs" in China.[334] Despite difficulties in estimating the size of China's energy efficiency market, Cheung and Kang of the World Resources Institute, writing in 2008, had projected a China energy efficiency market size for the period 2008 to 2012 averaging USD60 billion per year, a number roughly similar to Evans et al's USD67 billion estimate for the China's energy efficiency market in 2013.[335]

The huge potential for the Chinese energy efficiency market and therefore ESPs in China has been noted by many. One nongovernmental organization, for example, coveys an expert's findings as follows: "Energy intensity (as measured by kilowatt hour (kWh) per kilogram (kg) of converted resin) is about three times higher in China than it is in the United States for plastic injection molding, up to eight times higher for some painting and coating, and most small- to medium-sized enterprises (SMEs) should easily be able to find 20 percent gains over five to ten years."[336]

[332]Kostka and Shin, 2011, op. cit.
[333]Meredydd Evans et al, 2015, op. cit.
[334]Meredydd Evans et al, 2015, op. cit.
[335] Ray Cheung and Aram Kang, *New Ventures Feature No. 1: China's Booming Energy Efficiency Industry*, World Resources Institute, May 2008.
[336]Ryan Schuchard and Daniel Gross, *Unlocking Energy Efficiency in China: A Guide to Partnering with Suppliers*, Business for Social Responsibility, May 2010.

Number of Chinese ESCOs and ESPs: In 2011, there were 2,339 "ESCOs" registered with China's National Development and Reform Commission (NDRC), though 27 percent had been established only within the preceding five years. These companies together had 378,000 employees. Eligibility for government incentive grants and tax credits for energy performance contracting require NDRC registration. Yet, the criteria for registration do not require performance contracting, so that this large group of companies may be considered more broadly as ESPs. Criteria for registration are: a core business in energy conservation services, such as energy audit, design, retrofit, and operation; registered capital of at least five million RMB; and competent technical personnel and professionals.[337] Further, the *General Technical Rules for Energy Performance Contracting* issued by China's National Standardization Management Committee in 2010 define ESCOs as "any professional company that offers energy audit, energy-saving project design, financing, renovation (construction, equipment installation, setting), and operation and management services." Again, performance contracting is not specified, suggesting the group referenced be defined more broadly as ESPs. Terminology is confusing, as most analysts in discussing the China ESCO market limit it to those carrying out performance-based contracting.[338] Finally, as an indication of the minimum scale of the ESP market in China, an estimate of 3,900 companies has been made for the number of firms providing energy conservation services in China in 2011, including both those registered as ESCOs and those that are not registered.[339]

China's largest ESCOs appear to have substantial market share, implying significant consolidation of performance contracting in the nation. While the numbers indicate a consolidation level somewhat less than that in the US, which has only about 45 true ESCOs, some activity indicated as EPC activity in China, as discussed previously, may not be considered as such elsewhere in the world. According to available statistics, of the USD6.4 billion in performance based contracts in 2011 in China, less than five percent of the 2,339 registered ESCOs had annual contract revenues totaling over 50 million RMB (about USD7.7 million) each. This group, just over one hundred companies, was responsible for 65.6 percent of ESCO performance based contract revenues that year, with average performance based contract revenues of USD29 million per company.[340]

China's ESCO market size and growth: Data indicates the China performance-based ESCO market has grown extremely rapidly in recent years, growing from USD6.4 billion in 2011 to USD12.0 billion in 2013. This very rapid growth is believed in large part to have been stimulated by new Chinese Government financial incentives, including both cash grants and tax credits, for shared savings type energy performance contracts.[341] At the same time, some sources have indicated that China's shared savings type contracts do not include a performance-based incentive for the ESCO, whereby the ESCO would receive higher compensation should the energy savings be higher than targeted. This upside for the ESCO in shared savings type contracts is typical in the ESCO industry elsewhere in the world.

[337]China Energy Management Company Association (EMCA) for the International Finance Corporation (IFC), *China Energy Service Company Market Study*, 2013.
[338]Ding Ma, 2013, op. cit.
[339]EMCA for the IFC, 2013, op. cit.
[340]EMCA for the IFC, 2013, op. cit.
[341]Meredydd Evans et al, 2015, op. cit.

Typical scale of projects and payback period: The average size of Chinese ESCO projects ranged from USD100,000 to USD1 million from 2007 to 2009, substantially less than the typical range of USD2 million to USD15 million for US ESCO projects. The smaller contract size may be driven by the predominant dependence in China's EPC business on financing by the ESCO (via shared savings contracts), as the ESCOs have limited financial resources.[342] The average China EPC project size in 2011 was USD1.8 million.[343] The typical contract term for China's performance-based ESCO projects has been given as four to eight years, compared to ten to twenty years in the US.[344] As for payback, Cheung and Kang (2008) estimated an average payback period of only 1.8 years for China's performance based ESCO projects, much shorter than the payback period in developed economies.

Market forecast: Meredydd Evans et al (2015) have made high and low projections for the size of the China energy performance-based China ESCO market in 2020. Those projections range from USD17 billion to USD67 billion, based on 2005 constant prices and annual growth rates that range from 8.3 percent to 31.7 percent from the 2013 market size of USD12 billion. Evans et al also project that the share of ESCO performance based contracting in the overall ESP market will rise from 18 percent in 2013, to between 33 percent (modest change scenario) and 37 percent (accelerated change scenario) during China's 13th Five Year Plan Period of 2016 to 2020.[345]

Market segments: In contrast to the US, where the industrial sector is only a small part of the ESCO performance-based contract market, in China the industrial sector dominates. In 2013, 72 percent of the total value of energy performance contracts in China were industrial sector projects, while the building sector accounted for 21 percent and the transport sector (e.g. street lights), for seven percent. [346] The share of industry was even higher earlier on, accounting for 82 percent of revenues and 83 percent of energy savings in 2010 and 2011. China's building sector, in particular, is expected to see strong growth in ESCO projects going forward.[347] Evans et al (2015) note that industrial sector projects tend to require investment scales and risk management that only a few large ESCOs can handle, thus making this market difficult for the majority of small Chinese ESCOs to enter and prosper in. Yet, both because of its great savings potential and because it is the sector for which the government has established the most specific energy conservation targets (often on an enterprise-by enterprise basis for the largest companies), industry continues to be the largest ESCO market segment in China.[348]

Looking at the ESCO customer market in terms of small and medium sized enterprises versus large enterprises, Chinese ESCO performance-based contracting activity appears heavily skewed towards serving the large enterprises. Schuchard and Gross suggest that Chinese ESCOs usually focus on larger projects and thus ignore small and medium sized enterprises as potential clients. They note that most energy efficiency policies to date in China have

[342]Meredydd Evans et al, 2015, op. cit.
[343] EMCA for IFC, 2013, op. cit.
[344]Meredydd Evans et al, 2015, op. cit.
[345]Meredydd Evans et al, 2015, op. cit.
[346]Meredydd Evans et al, 2015, op. cit.
[347]EMCA for IFC, 2013, op. cit.
[348]Meredydd Evans et al, 2015, op. cit.

focused on a smaller number of the largest consumers of energy, though some of the more recent financial and tax incentives for performance-based contracting are inclusive of the SME sector.[349]

3.1.2 Industrial ESP/ESCO Projects in China

Typical scale of industrial EPC projects and payback: According to available sources, the average contract size of industrial sector EPC projects in China in 2011, at 16.5 million RMB (about 2.5 million USD), was somewhat larger than the average size of China EPC projects generally that year, which was 13.0 million RMB (about 2.0 million USD).[350] Data from 2007 to 2009 allows a comparison of the size of different types of contracts in the industrial sector. At that time, the average size of an industrial sector energy outsourcing project (whereby the ESCO is responsible for energy provision for a period of time) was 60.3 million RMB (about 8.4 million USD), that of an industrial sector guaranteed savings project was 15.2 million RMB (about 2.1 million USD), and that of an industrial sector shared savings project was 6.8 million RMB (about 950,000 USD).[351]

Typical types of industrial ESP projects to date: Sources indicate that China's industrial sector ESCO projects are usually equipment focused. Common industrial sector project types include: waste heat, waste gas, and waste pressure recovery; motor system upgrades; industrial boiler retrofits or renovations; technology upgrades in combustion systems; kiln and furnace retrofits or renovations; cooling system replacements; internal power supply renovations, and automatic control systems.[352] Exhibit 3-1 shows survey data on some of the most common types of ESCO EPC projects. Given industry's predominance in China EPC projects, this data yields insights on the most common types of industrial ESCO EPC projects in China. Three different types of data are presented: (1) one set on share of each project type in total EPC project volume, (2) one set on share of project type in total number of projects, and (3) one set on proportion of surveyed ESCOs considering each project type a main part of their business. For the last, ESCOs could name multiple project types and named 3.5 types on average. Interestingly, looking at EPC projects by volume for 2007 to 2009, waste heat and pressure recovery is the most invested measure. At 42 percent of total EPC project value, it leads the next most popular measure (boiler and heating systems, 18 percent) by far. Thus, at that time at least, waste heat and pressure recovery, which requires a relatively high level of investment, was a truly predominant type of ESCO project in China.[353] Similarly, it is also the most common project type by number of projects in the 2013 data set indicated, showing that its prevalence has continued. And, it is the second most common area of work for 446 ESCOs interviewed in 2012. Of these ESCOs, 47 percent indicated some work in the waste heat and pressure utilization area.

[349]Schuchard and Gross, 2010, op. cit.
[350]EMCA for IFC, 2013, op. cit.
[351]Meredydd Evans et al, 2015, op. cit.
[352] David Crossley of the Regulatory Assistance Project, presentation on *ESCOs in China* at ESCO Workshop sponsored by Nexant and King Mongkut's University of Technology in Thonburi, Bangkok, November, 2014; and Meredydd Evans et al, 2015, op. cit.
[353]EMCA for IFC, 2013, op. cit.

Exhibit 3-1: Most Common Types of ESCO EPC Projects in China

Note: Projects include all sectors, but vast majority of EPC project volume is in industrial sector.

By share of 2007-2009 EPC total contract volume (874 projects reviewed)	By number of EPC projects of each type in 2013	By proportion of ESCOs in 2012 that do projects in each area (446 ESCOs interviewed)
-waste heat and pressure recovery 42% -boiler and heating system 18% -motor system 17% -furnace energy saving 7% -other 6% -central AC 4% -green lighting 3% -heat pump 1% -alternative fuels 1% -energy management 1% -power supply system 0% -energy storage tech 0%	-waste heat and pressure utilization 1098 -green lighting 998 -motor drive system 550 -HVAC 340 -industrial boilers 200 -industrial enterprises energy management 160 -building smart control 152 -heating 50 -CHP 15	-oil conservation and substitution 50% -waste heat and pressure utilization 47% -energy saving motor system 46% -environment friendly illumination 42% -energy saving in buildings 39% -energy saving monitoring and technology systems 36% -coal fired industrial boiler and furnace renovation 34% -government energy savings 33% -regional cogeneration 14% -other 8%

Sources: Meredydd Evans et al, 2015, op. cit., and EMCA for IFC, 2013, op. cit.

The industrial projects are usually relatively specialized systems upgrades and independent of each other, rather than multiple, integrated measures.[354] Several sources have indicated that China's industrial sector projects are "low hanging fruit," meaning they have short payback times and are not that difficult. This market opportunity is due to the relatively inefficient nature of energy use in Chinese industry. Such projects would not be found in the US, for example. Yet, there is also a sense that the low-hanging fruit will all be picked eventually and that Chinese industrial ESCOs will need to move to deeper, more integrated solutions soon. At the same time, one analyst has noted that China's industrial ESCO projects, such as waste heat power generation, require a high level of customization due to their site-specific nature.[355]

Kostka and Shin (2011) concur with those who see China's ESCO industry as underdeveloped, providing simple piece-by-piece solutions, and selling products instead of services. Their interviewees suggest Chinese ESCOs offer only "standardized, 'copy and paste' solutions" with simple technologies. As one of their interviewees, the regional manager of a large foreign ESCO operating in China said, "Instead of offering entire energy solutions by combining different systems together, current investments are made only in standardized energy-saving projects such as changing light bulbs, motors, or boilers."

As for types of ESCO services, these are similar to those in other countries. Chinese ESCOs perform audits, undertake detailed project design, help secure financing, and manage project implementation. A pre-contract energy audit is needed for all EPC projects in China. For smaller projects, it is almost always provided for free. For larger projects, some ESCOs may charge for the audit to avoid associated losses if a contract is not signed. Yet, this is rare and the general practice in China is to offer the energy audit for free for both small and large

[354]Meredydd Evans et al, 2015, op. cit.
[355]Ding Ma, 2013, op. cit.

projects. Usually, the audits are performed by the ESCO, but in some cases clients request a third party get involved.[356]

3.1.3 China ESCO Business Models

Mix of business models and payback period: Performance-based ESCO contracts in China are of three main types: (1) shared savings, (2) guaranteed savings, and (3) energy management outsourcing (similar to *chauffage*). While similar to the Western ESCO contract types with the same names, there are some differences in the Chinese definitions. Each main contract type is described later in this section. The most notable difference, perhaps, is that shared savings contracts in China do not ascribe a variable benefit to the ESCO depending on energy saved. Instead, the ESCO receives a fixed amount, assuming a minimum baseline target of energy savings is met. Historically, the majority of performance-based ESCO contracts in China are shared savings contracts, though guaranteed savings contracts have seen some increase over time. In 2010 to 2011, 66 percent of contracts were shared savings, 20 percent guaranteed savings, six percent outsourcing energy management, and eight percent other types.[357] Shared savings contracts have traditionally been the most popular, both because (1) they most decrease risk for the end users (as compared to guaranteed savings) and (2) shared savings are the only ESCO contract type eligible for Government of China financial incentives, including both grants and tax credits. In the industrial sector, smaller projects most often make use of the shared savings model, whereas larger projects rely on the guaranteed savings model and the largest projects may use the outsourcing model.[358]

Contract periods range from three to twenty years, with periods of three to eight years most common. Average contract duration is expected to increase as the amount of "low hanging fruit" available decreases. Data on contract length and payback period confirm that China's ESCO projects have a shorter term and faster payback, on average, than those in the US. Based on a 2012 survey of 446 Chinese ESCOs, 75 percent of the performance-based contracts are less than five years in duration. The average payback period by company is three years or less for 71 percent of companies. Breaking this down further, of the 446 Chinese ESCOs surveyed in 2012: 127 (30 percent) had an average payback of less than two years; 175 (41 percent) had average payback periods of two to three years; 103 (24 percent) had average payback periods of three to five years; and only 20 (five percent) had average payback periods of over five years. [359]

Contract length varies by contract type: According to EMCA, the Chinese ESCO association, the typical length of shared savings contracts ranges from four to eight years, with some longer than 20 years. Guaranteed savings contracts, according to EMCA, tend to be short and used when the ESCOs lack sufficient funding and thus prefer fast payment from the host. Typical contract length for the outsourcing model, at eight to twelve years, tends to be the longest.[360]

[356]Ding Ma, 2013, op. cit.
[357]EMCA for IFC, 2013, op. cit.
[358]Meredydd Evans et al, 2015, op. cit.
[359]EMCA for IFC, 2013, op. cit.
[360]Meredydd Evans et al, 2015, op. cit.

While an increase in the share of guaranteed savings contracts has been seen over the years, there is also a downward force on their market share in that newly issued government ESCO incentives (subsidies and tax credits) are limited to shared savings contracts only. Energy management outsourcing contracts have increased significantly over the past few years. Analysts suggest that the popularity of shared savings has been due to its fit with China's abundance of quick payback projects and government financial incentives, yet could constrain future growth. Given the fast growth of China's economy, many industrial clients to date have been more interested in investing in expansion of production than in cost cutting measures, such as energy efficiency investment. They thus prefer the shared savings model. Yet, the cost of capital (in this case interest rates charged by ESCOs to their clients) is higher in shared savings projects. Further, ESCOs are capital constrained, limiting the scale of projects in a shared savings universe. Thus, the shared savings model tends to lead to less comprehensive projects.[361]

Description of main contract types: The main ESCO performance-based contract types in China are described below.

1. Shared savings: Internationally, for shared savings contracts, the ESCO arranges or provides financing. The cost savings from implementing energy efficiency measures is shared between the ESCO and the facility owner at agreed proportions for an agreed upon number of years. In China, the ESCO also arranges or provides the financing in the shared savings model. The ESCO may obtain these funds from a financial institution or use its own funds. Further, it may obtain a guarantee on future payment by the client from a guarantee company. ESCOs are paid over time by the client from the cost savings. The project must achieve a minimum cost savings agreed upon in the contract or the ESCO may not receive full payment. Yet, assuming that minimum cost savings is met, the client's payment to the ESCO is usually a fixed, agreed upon amount. It does not vary based on the total amount of cost savings beyond the minimum agreed amount. That is, any additional savings usually accrues in full to the client. This is a substantial difference with the international model of shared savings, which is more clearly "performance-based." The assets resulting from the project are usually owned by the ESCO until the contract period is completed. Then, the assets are transferred to the client, usually at no charge.[362]

2. Guaranteed savings: Internationally, in ESCO guaranteed savings contracts, the project is financed by the client. The ESCO guarantees a certain level of savings. Some or all of the resulting cost savings from improved energy efficiency in excess of the guaranteed amount goes to the ESCO. In China, for guaranteed savings, the client also provides the financing, either through their own funds or outside source (such as loan), which the ESCO may help them identify. The ESCO provides design and implementation and also guarantees a minimum savings. The ESO may receive a share of the cost savings beyond this level, yet this is not always the case, showing a difference between the international and Chinese models.[363]

[361]Meredydd Evans et al, 2015, op. cit.
[362]David Crossley, 2014, op. cit.
[363]David Crossley, 2014, op. cit.

3. Energy management outsourcing: In China, for an energy management outsourcing project, the ESCO finances and installs energy saving assets within the client's facility. The ESCO then operates these assets for a certain period of time for compensation, which can be either a pre-agreed set amount or linked to the energy savings/energy delivery achieved. The ESCO owns the assets for the duration of the contract and then transfers them to the client. A typical example of this type of contract is "BOT" (build-own-transfer) power generation using either waste heat or byproduct gas from manufacturing processes. For this type of project, the ESCO will install and operate the power generation equipment, purchase the process energy for a small amount from the client or receive it free of charge, and then sell the electricity to the client at a rate less than the cost would be to the client if purchasing power from the electric grid.[364]

3.2 Chinese ESCOs/ESPs

3.2.1 Nature and Types of Chinese ESCOs/ESPs

Scale, origins, geography, and other features: As mentioned, there were 2,339 registered "ESCOs" in China in 2011 and an estimated total of at least 3,900 companies engaging in energy efficiency services, whether registered as an ESCO or not. The 2,339 registered companies had a total of 378,000 employees.[365] The majority of Chinese "ESCOs" are small. Further, some sources question whether there are more than a small number (e.g. ten) true ESCOs in China. As mentioned, interviewees of Kostka and Shin (2011) describe an environment in which companies that are not true ESCOs register as ESCOs to get access to subsidies. In the environment they describe, comprehensive projects (as compared to piece-by-piece equipment upgrades) are rare. Other sources present a picture of a market consisting mostly of small companies. While large companies command the majority of the business, they imply that small companies still conduct EPC. For example, EMCA (2013) indicates that 676 of the 2,339 ESCOs registered in 2011 had not yet conducted an EPC. That would mean that 71 percent, or 1,663 companies, had. Further, EMCA indicates that of their survey group of 446 ESCOs in 2012, only six had not yet conducted an EPC. As has been mentioned, EMCA (2013) has noted that the less than five percent of the 2,339 ESCOs who each had annual EPC revenues of over USD7.9 million accounted for 66 percent of all ESCO revenues in 2011. This is a group with 100-plus companies. Ding Ma (2013) notes that there are about 20 large ESCOs in China, while the rest are small. According to a 2012 survey of 431 ESCOs, 229 (53 percent) had 50 persons or less, 104 (24 percent) had 50 to 100 persons. Only seven (less than 2 percent) have staff of over 1,000. Out of 446 ESCOs responding to the 2012 survey, 54 ESCOs (12 percent) indicate they have done over 20 EPC projects. [366]

In terms of the origins of Chinese ESCOs, sources find that some have been transformed from energy saving equipment providers, some have been transformed from engineering and facilities companies, and some were set up as subsidiaries of large companies. Reflecting the

[364]David Crossley, 2014, op. cit.
[365]EMCA for IFC, 2013, op. cit.
[366]EMCA for IFC, 2013, op. cit.

very strong trend of Chinese ESCOs being companies that sell their equipment, the EMCA survey in 2012 of 446 ESCOs found 78 percent of those have their own patents; and 39 percent have received the preferential designation from the Chinese Government of "high tech enterprise." Of those holding patents, 65 percent have patents in the "invention" category. Chinese ESCOs generally build on a core competency such as equipment, engineering, turnkey construction, or operational services and may partner with others to provide a full package to clients. More recently, large foreign ESCOs, attracted by government incentives, have begun to enter the market as well. Geographically, ESCOs are concentrated in three areas: (1) the Beijing area, (2) the Pearl River Delta (near Guangzhou in South China's Guangdong Province), and (3) the Yangtze River Delta (near Shanghai in East China). Of the 446 ESCOs surveyed in 2012, most are private.[367]

Types of Chinese ESCOs: Different means of classifying Chinese ESCOs yield further perspective on the market. Three ways of classifying ESCOs gleaned from the literature are presented here. These are: (1) by focus area (technology versus service versus capital provision); (2) by type of ownership (e.g. independent, state-owned industry subsidiary including utility subsidiary, foreign); and (3) by level of networks/ relationships with clients.

By focus area: One insightful way of classifying Chinese ESCOs is by focus area. Sources typically identify the main focuses area types as: (1) technology oriented, (2) market or consulting oriented, and (3) capital oriented. The first group tends to focus on a type of equipment, which they have developed. The second group is focused on service provision; and the third group is focusing on capital provision or strength in arranging financing. The technology focused ESCOs leverage their specific technology and patents. Due to their unique technology, they tend to be able to attract the support of financial institutions, which then leads to rapid growth. The market oriented or consulting oriented providers tend to provide "solutions," bringing together the best technologies from other companies for their client. Yet, they have more difficulty attracting support from financial institutions. The capital oriented ESCOs leverage their access to investment capital. They are flexible in terms of the technology they use and market on which they focus.[368] As mentioned, most Chinese ESCOs fall into the technology-oriented group, which includes equipment manufacturers (e.g. motors, boilers, lighting) and marketers of equipment for sale or lease. Because many of China's emerging ESCOs were originally providers of a single type of equipment, they lack the expertise to carry out comprehensive ESCO projects and also tend to focus on a narrow area due to their bias for selling specific equipment. At the same time, more ESCOs with a market/consulting focus and financial focus are emerging.[369] The consulting oriented companies may provide audits and other advisory series (instead of product sales and retrofits) for a fee. Some collaboration has been seen between consulting oriented and product oriented ESCOs to offer more comprehensive solutions.[370]

By ownership: Some of the key ownership types seen among China's ESCOs are: (1) private independent, (2) subsidiary of large state-owned company, (3) subsidiary of utility (also a

[367]EMCA for IFC, 2013, op. cit.
[368] Zhao Ming, *ESCO Development in China*, presentation to China-America Energy Efficiency Forum, San Francisco, May 2011; and Schuchard and Gross, 2010, op. cit.
[369]Ding Ma, 2013, op. cit.
[370]Schuchard and Gross, 2010, op. cit.

type of state-owned subsidiary), and (4) subsidiary of large foreign company. The bulk of ESCOs by number fit into the first category (private independent), though the subsidiaries of larger companies, through their better networks and financial capacity, may have more success in landing projects. The small, private ESCOs were the first to enter the market, sensing the opportunity presented by increasing focus on the area of energy efficiency and the role of programs and policies to support the ESCO sector. The entry of state-owned ESCOs, ESCOs that are subsidiaries of large state-owned companies, is a new phenomenon in China. Yet, there are a good number of such entrants, often emerging from some of China's most energy consuming state-owned enterprises. Examples of such major enterprises that have formed ESCOs include State Grid, Southern Grid, Baosteel, Sinochem, Sinopec, CNOOC, Shenhua, China Power Investment, Guangdong Nuclear Power, and Datang. These subsidiaries have advantages in establishing relationships with clients and in obtaining bank funding. Multinationals entering the China ESCO market, either through joint ventures or wholly owned subsidiaries, include Carrier, Philips, Honeywell, Siemens, and Schneider.[371] These companies hold a lead position in terms of having multiple products for more comprehensive projects. Yet, at the same time, it has also been noted that Chinese equipment-focused ESCOs, given their lower cost structure, may have a comparative advantage as they develop international markets.[372]

Of the state-owned ESCOs, the grid companies in particular have been stimulated to establish ESCO subsidiaries due to the recent obligation for demand side management. In 2011, the Chinese Government issued an energy efficiency obligation (EEO) for grid companies. The EEO requires the grid companies to achieve at least 0.3 percent energy savings annually via supply and demand side measures combined.[373]

By strength of networks and relationships: Kostka and Shin (2011) share interesting findings on the elements leading to success of Chinese ESCOs. In their view, the most critical element in ESCO success is relationships that facilitate landing projects with large, energy-intensive clients. In most cases, they find, it is the state-owned enterprise subsidiaries that have the best networks and relationships, which include links with local governments. In a new industry like the ESCO business, with its potentially complex and long duration contracts, trust is needed. And, Kostka and Shin find that subsidiaries of state owned enterprises are best able to achieve this trust with potential clients. They believe that most independent, private ESCOs are struggling due to a lack of ability to develop relationships with the large energy-consuming enterprises. It is not only that the state-owned potential clients don't trust them. In addition, they also have a lack of assurance that the clients will abide by shared savings contracts and pay them back accordingly. Kostka and Shin note that trust can be embodied in a product or in a person. In the Chinese ESCO business so far, as it is a relatively new business, the focus is more on the person. At the same time, they provide a case study of one private enterprise that has done well with such relationships due to the previous roles and connections of its founder. A barrier Kostka and Shin find to the success of most private, independent ESCOs in developing relationships is that, as a group, they are concentrated in

[371]Meredydd Evans et al, 2015, op. cit.; and Kostka and Shin, 2012, op. cit.
[372]Gang Tan, *Energy Efficiency in China: Opportunities and Challenges*, presentation at GARP Denver Chapter Meeting, April 2012.
[373]David Crossley, 2014, op. cit.

just a few areas of the nation and thus cannot leverage geographic colocation to build networks with most of their potential clients. The authors note, "In addition to EMCA membership, some private ESCOs try to market themselves, but they usually end up engaging in activities with low profit margins, such as a mere consultancy role. Thus, many private ESCOs are forced to exit the market within a couple of years or 'stop working as an ESCO and just lease equipment.'"[374]

3.2.2 Profiles and Experiences of Specific Chinese Industrial Sector ESCOs/ESPs:

This section provides brief summary profiles of seven Chinese industrial sector ESCOs/ESPs. All of the companies profiled have been indicated to be ESCOs in the literature. As noted, the Chinese ESCO sector may in some regards blend with that part of the ESP sector normally considered to be non-ESCO. At the same time, most of those profiled appear to be undertaking shared savings contracting. The profiles include both private ESCOs and those that are state-owned subsidiaries. The first two, Shenwu and Sinen En-tech, stand out because of their proprietary industrial technology. Shenwu, in particular, has met with tremendous success and growth and has expanded internationally. The next two, also with an industrial focus, are a listed company and a subsidiary of a state-owned equipment factory. Finally, the last three, DEED, Fakai, and Baoding Runli are taken from Kostka and Shin's (2011) analysis of networks and the ESCO industry. The profiles highlight the importance of relationships to the success of Chinese ESCOs. DEED, a private company with limited networks had some limited success at first, but could not grow. Fakai in its early stages was able to leverage the strong networks and trust accorded it due to its state-owned status and parent organizations. Baoding Runli, while private, is able to leverage the relationships of its founder, a former government official, as well as the ongoing relationships developed by its being in the same city as its current and potential clients. Kostka and Shin (2011) had also covered two foreign ESCOs in their analysis that are not profiled in this section. Of these, one had quite a bit of trouble with nonpayment by its clients and in the end decided to cut back on its ESCO activities. The other, an experienced ESCO from Canada, also aware of nonpayment issues, carefully screens potential clients. As Kostka and Shin note, this ESCO "initially identified more than 100 clients, but eventually decided to drop all but ten of them."[375]

1. Beijing Shenwu Environment and Energy Technology Co.: Shenwu was established in the suburbs of Beijing in 1999. It is considered one of China's most successful ESCOs and has achieved great success by leveraging its patented technologies and selling its equipment. At present, Shenwu describes itself as specialized in "new technology development, engineering design, and EPC of various types of industrial furnaces." Its core technology is a regenerative high temperature air combustion technology, which it manifests as the "Shenwu Industrial Furnace." Shenwu designed and built the "first reheating furnace with installed regenerative burner" in China, which was successfully put into operation in 2001. Its business continues to focus on providing low-carbon and environmentally-friendly solutions for industrial furnaces for the steel, non-ferrous metal, mechanical equipment, building material, and other sectors.

[374]Kostka and Shin, 2011, op. cit.
[375]Kostka and Shin, 2011, op. cit.

In general, its market is heavy industry companies that require use of high temperature boilers and furnaces. Shenwu has a "construction enterprise Class A furnace project contracting qualification." Shenwu indicates its regenerative heating furnaces can save about 30 percent energy on average. Over 50 percent of employees work in R&D, engineering, and technical departments.

Since its founding, Shenwu has achieved substantial scale. Its assets as of end of 2013 were 5.5 billion RMB (or about USD873 million). It has eight subsidiaries and 2,800 employees and has begun doing projects in other countries. Shenwu has 127 patents granted in China and in other countries and another 130 patents under approval. Illustrating its rapid growth, between 2004 and 2007, revenues rose from USD6 million to USD286 million. Also by 2007, Shenwu had already developed a number of clients among steelmakers in Japan, South Korea, and Europe due to its cost competitive industrial regenerative heating systems. In 2008, Shenwu's high temperature air combustion (HTAC) systems were selling for USD1 million to USD14 million and clients could expect to receive payback in two to three years. Shenwu is said to use the shared savings model for its projects.[376]

2. Beijing Sinen En-tech Company: Sinen En-tech produces specialized technologies for treating the waste in steam used for industrial boiler systems. The company has patented micro-filtration membrane systems that purify the steam used into high temperature water that can be recycled, reheated, and used again in the industrial boilers. By reducing metal and petroleum content in the steam, Sinen's systems reduce energy and water consumption as well as wastewater pollution. According to information from 2011, Sinen's system costs clients between six and seven million RMB (around USD920,000 to 1.1 million) and saves them about 10 million RMB (about USD1.5 million) in energy costs yearly. Thus, the system pays for itself in seven to nine months. Clients are industrial companies in sectors such as petroleum, steel, and textiles that regularly use steam for industrial production. Other sectors such as pharmaceuticals, thermal power, and alcoholic beverages are a potential market. The company began its business focusing on the oil refining industry, with the majority of its clients from Sinopec, one of China's three largest state-owned oil companies. The founder Yucheng Yang was previously an energy efficiency researcher at a Chinese research institute. Beijing Sinen En-Tech was established in 2001. Beijing Sinen En-tech's business model (based on information from 2008) is to enter into long-term after-sale services and equipment maintenance contracts with customers. Revenues come from a mix of after-sales services and product sales. In 2008, Sinen En-Tech was the only Chinese supplier whose products could treat industrial steam heat at high temperatures. While there are international competitors, foremost of which is Armstrong, Sinen En-Tech has a significant cost advantage over those producers. Revenues in 2007 were USD14.3 million.[377]

3. "Company A" (Ding Ma, 2013): Presented as an anonymous interview by Ding Ma (2013), Company A was established in 2010 and is a listed company. It focuses on waste heat power

[376] Shenwu website at www.shenwu.com.cn ; and, for information from 2007 and 2008, Ray Cheung and Aram Kang, 2008, op. cit.

[377] General information and information from 2011 from Tracy Elsen, *Environmental Entrepreneurs: Beijing Sinen En-Tech Saves Water with Steam Recycling*, April 2011 accessed at World Resources Institute Blog in Nov. 2015 at http://www.wri.org/blog/2011/04/environmental-entrepreneurs-beijing-sinen-en-tech-saves-water-steam-recycling ; and, for information from 2007 and 2008, Ray Cheung and Aram Kang, 2008, op. cit.

generation. At present, company A is one of the companies with the most ESCO projects in the waste heat power generation area. Most clients are in the cement and glass industries and most are large, state-owned enterprises. At the end of 2011, the company had 17 operating projects, three under construction, and nine in the planning phase. Revenues that year were 183 million RMB (about USD28 million) and profits 52 million (USD8 million). All projects were of the shared savings model type, with general project duration of 20 years and payback period of five to six years.[378]

4. "Company D" (Ding Ma, 2013): Presented as an anonymous interview by Ding Ma (2013), Company D was previously mainly an equipment supplier and is new to energy performance contracting. Yet, the company, with 900 employees and its own production facilities in two cities, is quite large. The company is one of nine subsidiaries of a large "group corporation," which was formerly a logistics institution of the Chinese military. The company's focus is on providing waste heat and pressure reuse in industry, as well as industrial boiler upgrade services. Customers are mainly large state-owned enterprises.

5. Dalian East Energy Development. Ltd. (Kostka and Shin, 2011): Dalian East Energy Development, Ltd. (DEED) is a privately-owned ESCO specializing in waste heat recovery technology. It was set up in 2006 and is a joint venture between Dalian East, Ltd., Dalian East Energy Development Holding Company, and the Global Environmental Institute (GEI). GEI is a non-governmental organization (NGO) based in Beijing. The NGO helped the ESCO obtain seed capital from an American foundation. The firm's clients, all private cement factories (as of 2011), were obtained through the networks of the CEO and manager of the ESCO. The factories are located in Zhejiang, Fujian, and Liaoning Provinces. Both the CEO and manager of DEED used to be in the cement industry, one in a government role and one working in cement factories. The manager and CEO were able to identify trustworthy clients, who could be counted on to fulfill their side of the deal. At the same time, they were trusted by the clients to enter into ESCO agreements. In 2011, DEED had projects with three clients, all of which were making payments to the ESCO on time. These three projects had been developed over a period of six years. Yet, DEED struggled to expand its business beyond those three projects. According to Kostka and Shin's analysis, the problem is that the networks of the CEO and manager were not broad enough. They did not have contacts beyond the cement industry. And, even within the cement industry, their networks can be seen to be limited when it is considered that the industry is so huge in China, with over 5,000 factories reported in 2005. Further, DEED did not develop much of a local network in the cities in which it was working. Finally, DEED was also apprehensive about working with new clients it did not know well for fear of being taken advantage of via nonpayment in a shared savings contract situation. As of 2010, DEED's shareholders decided to stop pursuing new projects.[379]

6. Hebei Fakai (Kostka and Shin, 2011): Hebai Fakai is a recently established ESCO set up in the public sector by the Hebei Province Demand-Side Management and Instruction Center (DSM Center), which, in turn, is fully invested with state-owned capital and established by the provincial government. According to Kostka and Shin, while relatively new at the time of their writing, Hebei Fakai was benefiting fabulously from the networks and trust it has as a

[378]Ding Ma, 2013, op. cit.
[379]Kostka and Shin, 2011, op. cit.

state-owned entity. It also had no trouble with access to capital. At the time of Kostka and Shin's work, there was some concern as to whether Fakai could develop the expertise needed to learn the ESCO business and deliver projects effectively. Yet, in terms of access to capital, a barrier to the vast majority of ESCOs, Fakai was able to quickly build up its investment in projects to 100 million RMB (USD14.8 million) in 2010; and 90 percent of that investment was equity. In July 2010, Fakai signed a contract with Longhai Iron and Steel in Hebei Province to install a heat recovery system and steam-powered turbines to use the facility's own waste heat to generate electricity. In addition to a higher potential for trust with clients, Fakai had access to a project pipeline through the DSM Center and the provincial government.[380]

7. Baoding Runli (Kostka and Shin, 2011): Baoding Runli is a private ESCO that entered the market in 2010. Initially established in 1985, it was previously a pure equipment manufacturer. Its main ESCO business is the recovery and recycling of residual heat from waste gas in industrial boilers. After just one year of operation, Runli had already signed EPCs with eleven different companies in the same locality. On average, the projects each saved about one million RMB (about USD148,000) worth of energy in 2010. Ruili's share of the savings was thirty percent. Kostka and Shin's analysis suggests the success of this company is largely due to the networks and relationships of the founder and CEO, who formerly worked in the local government. At the same time, the company's being based in Baoding where its clients are allows it to continually build relationships with them and others through ongoing interactions. Baoding Ruili had also developed those relationships prior to its ESCO days when it was a pure equipment manufacturer. In sum, Baoding Ruili was able to successfully leverage networks and relationships for its new ESCO business. This is something that Kosta and Shin found to be rare for private ESCOs, which usually lack the kind of networks that state-owned enterprise subsidiary ESCOs have.[381]

3.3 Drivers and Barriers of the China ESCO and ESP Market

This subsection first introduces the group of general drivers that are propelling growth of China's ESCO and ESP markets. It then explores in more detail policy drivers, which have become quite important drivers of ESCO business in China. Finally, it looks at some of the key barriers to a well-functioning and robust ESCO market in China.

General areas of drivers propelling the growth of China's ESCO and ESP markets are: (1) government policies requiring increased energy efficiency; (2) increased prices of energy; (3) donor projects promoting energy efficiency in general and ESCOs in particular; (4) government financial incentives for EPC business (particularly shared savings contracts), including grants and tax credits for projects; and (5) government regulations and guidelines promoting the smooth development of the ESCO industry.

Donor projects promoting energy efficiency in general and ESCOs in particular have been extensive in China and continue today. These projects have channeled technical assistance

[380]Kostka and Shin, 2011, op. cit.
[381]Kostka and Shin, 2011, op. cit.

and know-how, holding many training sessions, conferences, and sessions of one-on-one assistance. Donor projects have also featured investment funds and pilots of financial mechanisms. The World Bank, International Finance Corporation, Asian Development Bank, Germany's KfW, and France's ADEME are among the donors that have been involved in promoting both energy efficiency in general and ESCOs in particular in China.[382] The World Bank, in particular, with its GEF-funded China Energy Conservation Project Phase One, provided grant funds to three pilot Chinese ESCOs to enable them to finance projects. In Phase Two of this project, efforts were made to extend the pool of developing ESCOs through technical assistance and capacity building. In addition, Phase Two included a USD26 million investment grant to set up a fund to be used to guarantee commercial bank loans to ESCOs. Since then, both the World Bank and IFC have continued to work with financial institutions to encourage them to make funds and relevant new financial products available to ESCOs.

On an individual company level, Ding Ma (2013) interviewed six Chinese ESCOs and asked them which drivers they perceived as most important to their business. Resulting responses indicate that the demonstration effect of successful projects, the standardized contract model promoted by the government, financing through capital markets, and cooperation with experts from educational and research institutions were the most important perceived drivers of the ESCOs interviewed.

3.3.1 Policy Drivers

Key policies driving the ESCO business (and to some extent the broader ESP business) are: (1) national level energy efficiency policies and programs, including planning requiring that energy conservation targets be met; (2) policies for standardizing energy performance contracts and measurement and verification of savings; (3) national subsidies for shared savings energy efficiency projects, national tax credits for ESCOs, and other national measures to support ESCOs; (4) policies requiring utilities to implement demand side management; and (5) local government financial incentives for EPC projects and ESCOs. Each of these is covered, in turn, below.

1. National level energy efficiency policies and programs, including planning requiring that energy conservation targets be met: Chinese government policies requiring increased energy efficiency have set specific targets at the national level and also devolved specific targets to the provincial and local levels. The evaluation of local officials may be tied to these targets. Targets are then specified down to the level of some of China's largest high energy consuming enterprises. It is in part due to this reason that these enterprises have been perhaps the most fruitful targets for China's ESCOs and other ESPs. National, provincial, and local targets are in the form of energy consumption per unit GDP. The Government has also had a program for setting targets for and assessing progress of the top 10,000 energy consuming entities in China. While most national measures have focused on the nation's top energy consuming enterprises, the Government has also created income tax policies (*SME Energy-*

[382]EMCA for IFC, 2013, op. cit.

Efficiency Guidelines) for reducing or waiving the taxes of small companies that can document energy savings and the phase-out of old equipment.[383]

In addition to the foregoing, the national government has also taken other measures. According to China's Energy Conservation Law (amended in 2008), local governments are supposed to submit to the central government annually energy conservation plans, enact taxes on the most energy consuming industries, and create financial incentives for qualified energy conservation projects. With a focus on cutting energy consumption of energy-intensive industries, such as steel, nonferrous metals, construction materials, and chemical processing, not only have specific targets been set at the national level, but also tax incentives for energy-intensive enterprises have been eliminated. (Specifically, export tax rebates have been eliminated for energy intensive industrial sectors.) Central government energy efficiency investment funds have also been set up. The Government has also raised electricity prices.[384]

2. Policies for standardizing energy performance contracts and measurement and verification of savings: China has worked to standardize EPC contracting procedures and develop national standards for monitoring and verification of energy savings. To date, however, the contracting efforts are focused only on shared savings contracts. China issued *General Technical Rules for Energy Performance Contracting* in 2010. This is a recommended national standard, with definitions and general technical requirements that EPCs should meet, including audits, baseline determination, and measurement and verification. Analysts indicate some concern that not having other model contract types may constrain development of the ESCO industry in China.

China has issued a number of measurement and verification protocols, including *Calculating Methods of Energy Saved for Enterprises* in 2009, a recommended national standard for the estimating the energy saved. It has also issued *General Technical Rules for Measurement and Verification of Energy Savings*, a recommended national standard issued in 2013 that provides definitions, calculation methods, and standard practices related to measurement and verification (M&V) of energy savings. These *General Rules* adopt the guiding principles of the *International Program Measurement & Verification Protocol* (IPMVP). In 2013, China began developing a series of system and industry focused national standards for M&V known as *Technical Requirements for Measurement and Verification of Energy Savings.* Eight draft standards have been released for public comment, two in 2013 (for fans and pumps) and six in 2014 (sheet metal heating systems, residential building heating systems, cement waste heat power generation projects, telecommunication stations, lighting systems, and central air conditioning systems). China is also working on its *Energy Savings Measurement and Verification Implementation Guide*. Evans et al (2015) express concern that, despite all this good work on specific systems, a more comprehensive M&V protocol covering multiple systems is needed, particularly once China's ESCOs move to more comprehensive, integrated solutions for clients.[385]

[383]Schuchard and Gross, 2010, op. cit.
[384]Ray Cheung and Aram Kang, 2008, op. cit.
[385]Meredydd Evans et al, 2015, op. cit.

3. National subsidies for shared savings energy efficiency projects, national tax credits for ESCOs, and other national measures to promote ESCOs: As a part of the amendment to China's Energy Conservation Law, which took effect in 2008, ESCOs were recognized with legal status. Then, in 2010, two major measures were published, one for providing financial incentives for shared savings EPCs and one for tax credits for ESCOs. In addition, as a preface to these two measures, an earlier circular that year (April 2010) issued by the Ministry of Finance (MOF), the National Development and Reform Commission (NDRC), the Central Bank, and the Tax Bureau outlined measures for promoting ESCOs via (1) financial incentives, (2) tax incentives, (3) improved accounting rules, and (4) improved financing opportunities. This document is entitled *Opinions on Accelerating the Promotion of Energy Performance Contracting to Boost the Energy Service Industry*. All the measures in it will require detailed implementing regulations, as were issued for the first two topic areas later that year.

The financial incentive policy was published by the Ministry of Finance (MOF) and the National Development and Reform Commission (NDRC) in June 2010 with the aim of providing 2 billion RMB (about USD317 million) annually in incentive funds for EPC projects. The localities were encouraged to follow with more funds. The measure calls for qualified shared savings EPC projects to receive 240 RMB (or USD 40) per ton of coal equivalent energy saved plus at least 60 RMB (USD 10) per tce from provincial and municipal governments. (These figures are equivalent to USD1.11 per thousand Btu and USD0.28 per thousand Btu, respectively.) This policy is believed to drive a preference for shared savings contracts, as subsidies are only provided in the case of such contracts. To qualify for the subsidy, the ESCO must cover at least 70 percent of the project investment and comply with the *General Technical Rules for Energy Performance Contracting*, as well as sign a shared savings energy performance contract with the client based on the standard contract format. To qualify, industrial projects should achieve energy savings ranging from 500 to 10,000 tce; and projects in other sectors should achieve between 100 and 10,000 tce of energy savings. According to statistics, around 500 ESCOs submitted over 1,000 EPC projects worth 4 billion RMB (about USD660 million) to receive national incentives in 2013.[386]

In December of 2010, MOF and the Tax Bureau published tax incentives for ESCOs that meet the required criteria. To understand the tax incentives, it may be useful to first understand the national-level taxes that an ESCO is subject to in China. These are: (1) operational/business tax of five percent when energy saving services are provided, (2) a value-added tax of 17 percent when the ESCO transfers an asset to the client (transfer is treated as a sale), and (3) corporate income tax of 25 percent on net income. The new policy allows qualified ESCOs to receive ongoing full exemption from the operational and value-added taxes. Further, it allows them full exemption from the corporate income tax on any shared savings EPC projects carried out in their first three years of receiving revenue, and 50 percent income tax reduction for such projects for up to three additional years. Further, in terms of tax accounting, in the case of shared savings projects, any fixed or intangible assets can be depreciated or amortized in full over the contract period. This creates greater benefits for shorter projects, since the depreciation and thus tax benefit comes more quickly. ESCOs

[386]EMCA for IFC, 2013, op. cit., and Meredydd Evans et al, 2015, op. cit.

must register with both the national and provincial government to receive these tax benefits. As a result of the 2010 financial incentive policy and the 2010 tax incentive policy combined, there was a rapid rise in the number of ESCOs and some increased preference for shared savings projects.[387]

4. Policies requiring utilities to implement demand side management: As mentioned, in 2011, the Chinese Government instituted an energy efficiency obligation (EEO) on grid companies. This requires them to achieve at least 0.3 percent annual energy savings of combined supply and demand side energy savings. The result is that the grid companies have established subsidiary ESCOs to help them achieve targets.[388]

5. Local government financial incentives for EPC projects and ESCOs: Some major cities and regions in China have gone well-beyond the required level in supplementing the national ESCO incentive policy. For example, the Beijing Municipal Government has increased the combined national and local funding level from its minimum of 300 RMB (USD50) per tce saved to 800 RMB (USD133) per tce saved. They have also lowered the incentive threshold. For industry, any retrofits that save more than 100 tce are included (whereas the minimum is 500 tce in the national program). For non-industry, the minimum is 50 tce instead of 100 tce. Beijing has also already begun to promote other forms of ESCO contracts. In particular, *chauffage* (energy management outsourcing) projects that generate savings of 300 tce or more are qualified for 360 RMB (USD60) per tce of measured savings.[389]

Shanghai provides a local incentive amount of 300 RMB (about USD44) to companies for every tce saved, with a minimum of 500 tce and a maximum payout of 3 million RMB (about USD500,000) to any one company. The city also has developed a fund to promote various energy efficiency activities, including contract energy management.[390]

Of special interest to Turkey, perhaps, is that the cities of Guangzhou and Dongguan, both in Guangdong Province, have focused their energy efficiency guidelines and incentives on small and medium-sized enterprises. Among these are, in Guangzhou, 200,000 RMB (about USD33,000) rewards for companies that can pass clean production audits and 200 RMB (about USD33) for each tce saved. The latter can be provided to either the ESCO or the client. For factories that retire old, inefficient equipment, Guangzhou provides special funds (1.5 percent of fixed asset investment up to 2 million RMB or about 330,000 USD). Guangzhou has also announced that it plans to promote ESCO work with additional funds and seems to be striving to attract more ESCOs to the city. Dongguan provides 100,000 RMB to companies that can pass clean-production audits and 50,000 RMB to energy-consuming enterprises, ESCOs, industrial associations, and township governments that have outstanding achievements in energy efficiency.[391]

Chengdu, located inland in Sichuan Province, does not have as strong of incentives as the coastal cities listed. Still, it is taking measures. The city government will provide 100,000

[387]Meredydd Evans et al, 2015, op. cit., and EMCA for IFC, 2013, op. cit.
[388]David Crossley, 2014, op. cit.
[389]Meredydd Evans et al, 2015, op. cit.
[390]Schuchard and Gross, 2010, op. cit.
[391]Schuchard and Gross, 2010, op. cit.

RMB (about 17,000 USD) for industrial energy efficiency retrofits of more than one million RMB (about USD170,000) and an additional 50,000 RMB (about USD8,300) for each additional one million RMB invested. Non-industrial projects can get the same funds for projects over 300,000 RMB and for each additional 500,000 RMB invested. Chengdu also offers local income tax breaks of 1.5 percent of the value of energy-efficiency projects over one million RMB (about USD170,000) with a ceiling of two million RMB (about USD340,000).[392]

3.3.2 Barriers

Despite the very strong policy incentives and faster payback times in China, analysts have identified several barriers to the development of the ESCO industry there. Primary among these is lack of access to financing. Particularly because most ESCOs are SMEs and their business is service based, they lack assets, which makes it difficult to get loans from banks. For many, there is further a lack of track record and a lack of familiarity by the banks for what they do. Another key barrier is lack of comprehensive M&V protocol and institutional capacity for carrying out M&V. There is a lack of reliable measurement equipment, baseline data, and third-party institutions to carry out M&V. As a result, many parties decide to agree to a fixed payment between the client and the ESCO down the line. Yet, this can lead to problems later if the client feels the project has not delivered the promised savings. Another barrier is lack of credit-worthiness and lack of a strong credit system in China. As such, it is difficult for clients to have confidence in ESCOs. ESCOs, in turn, are understandably worried about getting paid by their clients. It is difficult for them to assess the financial situation of potential clients. As a result, the ESCO market tends to focus on state-owned enterprise hosts, but these are difficult for the bulk of small, private ESCOs to land as clients.[393]

Other barriers are related to the other contract models besides shared savings. As mentioned, the current favoring of the shared savings model by government incentives creates a lack of motivation for ESCOs to try other models. Yet, at the same time, the shared savings model constrains the scale and number of projects, as the ESCOs must provide at least 70 percent of the project cost up front to be eligible for incentives. Further, there is a lack of standard contract procedures for the other models besides shared savings.[394]

Some other ESCO barriers noted in China for industrial clients are similar to those noted for industrial clients in the US. For example, some industrial clients have in-house capabilities and are able to handle matters themselves. Other potential industrial clients, for reasons of preserving trade secrets, do not want ESCOs to have access to their core processes. They may also have concerns about interruptions to production. And, further, large industrial clients may have a complex structure and decision making process that is difficult for ESCOs to navigate.[395]

Ding Ma (2013) interviewed six ESCOs and asked them about the most important barriers they saw to improving their business. The most important barriers they mentioned include

[392]Schuchard and Gross, 2010, op. cit.
[393]Meredydd Evans et al, 2015, op. cit.
[394]Meredydd Evans et al, 2015, op. cit.
[395]EMCA for IFC, 2013, op. cit.

intense competition for customers and experts. They also mentioned uncertainty in market dynamics, such as abrupt mergers and acquisitions. They further mentioned the complexity in getting projects approved and difficulties in financing.[396]

3.4 Financing of Chinese ESCO Projects

This subsection first reviews the available data on financing of ESCO projects in China. It then reviews the major types of financial institutions involved and type of financing they provide. Finally, it provides information on the measures and experiences of selected Chinese commercial banks with regard to ESCO financing.

3.4.1 Breakdown of Financing

As mentioned, financing is one of the major barriers to growth of the Chinese ESCO sector. Looking at the breakdown of financing, it turns out that bank loans provide just 21 percent of EPC financing that ESCOs bring to their projects. Indeed, many ESCOs finance their shared savings contracts with close to 100 percent equity. Further, less than a fifth of ESCOs appear to have had access to bank loans. And, many of those that have had access, still indicate that financing is a problem. Clearly, the small, private firms face the greatest challenge, while ESCOs that are subsidiaries of large state-owned enterprises may have the easiest time in securing a loan. Data and further explanation and details with regard to these findings are given below.

Total bank loans used in 2011 by ESCOs in China for EPC projects amounted to 7.79 billion RMB (or about 1.2 billion USD). This represents only about 21 percent of all EPC financing provided by ESCOs in China. Indeed, of registered Chinese ESCOs, only 18.4 percent or 431 ESCOs, had secured bank loans. Many ESCOs finance their projects with almost 100 percent equity. Despite the growth of the ESCO industry, the large proportion of equity invested by the ESCOs suggests an imbalance in the industry. The average scale of loans of those ESCOs that did receive them was only 15.9 million RMB (about USD2.4 million). In fact, half of the ESCOs that received bank loans had loans of under 5 million RMB (about USD770,000). A small group of 36 ESCOs (or 2 percent of total registered ESCOs) were responsible for 65 percent of the bank loans by volume, averaging 142 million RMB (about USD21.8 million) per company. In general, these trends reflect that there are a lot of newer, small companies that are ESCOs that lack access to capital. A much smaller proportion are larger ESCOs that have developed strong track records and the ability to carry a large volume EPC portfolio with support from commercial banks. Yet, even these larger ESCOs may have financed a large portion of their projects with equity in the past. Therefore, they may represent good opportunities for “take out” capital, whereby revenues from ongoing, clearly successful projects serve as payment guarantees for taking out loans for new projects.[397]

[396]Ding Ma, 2013, op. cit.
[397]EMCA for IFC, 2013, op. cit.

The set of 446 ESCOs surveyed by EMCA in 2012 had a higher proportion accessing bank loans than the industry overall. Of the group, 323 (or 72 percent) had outside financing and 47 percent had had a bank loan. Other means of financing included leasing and parent company financing. Despite the large proportion of the survey group that had received outside financing (72 percent), of the 446 participating in the survey, 322 claimed difficulties in obtaining financing. This shows that even companies who have received bank loans or other outside financing perceive financing difficulties. A good portion of those not facing financing difficulties are the subsidiaries of state-owned enterprises or listed companies. Companies that did have difficulties, even when they obtained a loan, often had to use the company owner's home or other personal guarantee to qualify for the loan. Those expressing financing problems indicate the number one issue is that banks don't understand ESCOs. The number two issue they indicate is lack of guarantee to obtain loans. Among forms of outside financing, bank loans are the most popular among ESCOs and provide lower costs than some of the other options, such as financial leases and equity investment by third parties. Given many years of projects and capacity building by international financial institutions, several Chinese banks have now developed special products to loan money to ESCOs. These banks and their products will be discussed later in this section.[398]

3.4.2 Types of Financing

Analysts of China's ESCO industry present a broad spectrum of types of financial institutions and types of financing relevant to promoting the nation's ESCO industry. Below, many of these options are described briefly. Yet, despite the range of options, loans from commercial banks, with the lowest cost of capital, continue to be the preferred third party financing option of Chinese ESCOs.

1. Commercial banks: Loans from commercial banks (either to the ESCO for shared savings contracts or to the client for guaranteed savings contracts) are the preferred form of third-party financing for performance-based contracts in the ESCO sector. Among forms of third-party financing, they generally have the lowest cost of capital. Through various international donor programs, China's banks have been encouraged to develop financial products for ESCO projects. While previously not available, more recent news implies that Chinese banks are in some cases allowing loans to be issued based on future expected cash flows of the project being financed or on a combination of cash flows from ongoing projects and the new one being financed. Still, surveys show that requirements of collateral (sometimes personal) continue to challenge ESCOs in obtaining loans. The concept of "project finance" (finance not requiring collateral, but based on future cash flows of the project) is still challenging to implement in the context of the China ESCO market. Details on measures taken by individual Chinese banks in this regard are offered later in this section.

2. Guarantee companies and guarantee funds: Guarantee funds or guarantee companies can facilitate commercial bank loans to ESCOs by providing guarantee of loan repayment in the absence of sufficient collateral for a traditional collateral-based loan. The insertion of the third party guarantee organization, in a sense, allows ESCOs to "guarantee" their loans in part or in full by expected revenues from EPC projects. Phase Two of the World Bank China

[398]EMCA for IFC, 2013, op. cit.

Energy Conservation Project set up a USD26 million guarantee fund for ESCOs. China National Investment and Guarantee Company (China I&G) became the manager of the fund. Even after project close, China I&G continues to manage the guarantee fund. Since 2010, more guarantee firms have gotten involved or at least interested in the business of guaranteeing loans to ESCOs for EPC projects. Such firms include Capital Investment & Guarantee and Zhongguancun Hi Tech Guarantee. Huazun Investment and Credit Guarantee, a guarantee agency designated by NDRC to serve SMEs, has launched special products for ESCOs and targeted energy services as a key area. They have set up a special office for evaluation and review of ESCO projects and have developed a receivables based loan product.[399]

3. Financial leasing companies: Financial leasing companies provide a financial solution to ESCOs and their clients whereby equipment can be leased with payments over time, rather than purchased for a large, up-front amount. The leasing companies assist with procurement, investment, and management of the leased assets. In China, financial leasing companies can be financial institutions or non-financial institutions. There is increasing interest from such organizations in China in energy efficiency. One of the initial demo ESCOs in China supported by Phase One of the World Bank China Energy Conservation Project (Shandong Energy Engineering Co.) transformed itself into a leasing company in 2007. Another (Beijing Yuanshen Energy Saving Technology Company) set up a financial leasing company with the help of its parent company to help other ESCOs solve their financial problems. As an international example, Siemens Leasing Company uses the products of its parent company to provide leasing services to ESCO projects in China. Larger ESCOs with good financial strength may be both an ESCO and a provider of leasing services to smaller ESCOs.[400]

4. Forfeiting or factoring: Forfeiting or factoring is a financing tool whereby a business (such as an ESCO) sells its account receivables to a third party (such as a bank) at a discount to secure financing. In 2010, the Beijing Environment Exchange set up an EPC investment and financing trading platform, which will allow third party entities (such as banks) to buy the future receivables of EPC projects at a discount, thus paying the ESCOs for the projects as soon as they are completed.[401]

5. Insurance and insurance companies: Insurance is another type of financial tool that is being explored to support the ESCO business in China. China United Property Insurance Company Limited (CUPIC, China's fourth largest insurer) recently issued a new product called "energy performance guarantee insurance." The product works in the guaranteed savings project scenario, in which the client of the ESCO takes out a loan with the bank to finance the EPC project. If the ESCO's work does not end up delivering the savings promised, the insurance company will compensate the ESCO's client so that it can repay its bank loan.[402]

6. Donor financing: As indicated, international donor projects have played an active and influential role in developing China's ESCO industry. Some of these donor projects have set

[399]EMCA for IFC, 2013, op. cit.
[400]EMCA for IFC, 2013, op. cit.
[401]Meredydd Evans et al, 2015, op. cit.
[402]Meredydd Evans et al, 2015, op. cit.

up funds that can be a source of financing for ESCO projects. For example, the Asian Development Bank (ADB) provided a loan of USD100 million to support energy efficiency projects in Hebei Province. The provincial government is using the money as a revolving loan fund. In general, donors, such as the World Bank and French Development Agency, have worked to set up a range of energy efficiency loan products. They work with domestic Chinese financial institutions, which act as intermediaries to loan the donor funds, in combination with their own funds, to ESCOs and ESCO clients.

7. Private equity funding, bonds, and public listing: A number of other financing mechanisms for ESCOs have begun to appear in China. These are associated with firms involved in private equity and venture capital investments, bond issuance, and stock marketing listing. While still limited in extent, greater and greater interest from these segments of the financial sector is being generated. While it is hard to assess the exact amount of private equity and venture capital investment in Chinese ESCOs, there has been clear interest from these types of organizations in opportunities to invest equity in ESCOs. In particular, these parties tend to be attracted to ESCOs with their own unique technologies. Bond issuance may be another option for ESCOs needing to quickly raise capital. While it has in the past been difficult for SMEs to issue bonds, the Government's 2012 *Measures of Pilot SME Bonds* created a new channel for this that may be relevant for ESCOs. Finally, the public markets have begun to see listings of ESCOs. Top Resource Conservation Engineering Co., Ltd., specializing in heat recovery utilization, became the first IPO of a China-focused ESCO company when it was listed on the Shenzhen Exchange in 2012. Tianhao Energy Saving Technologies followed with a listing also in 2012; and Shenwu (profiled earlier in this study) listed in 2014. A total of over 80 listed Chinese companies are said have EPC business. This presumably includes many listed companies that have set up ESCO subsidiaries.[403]

Further evidence of rising interest in ESCOs among those in the investment community is as follows: Chinese securities companies have invested directly in ESCOs; and many of the major firms have staff assigned to specifically study the ESCO industry. Cases of investment firms investing in ESCOs include: "Jiuding investment in Coolead, Beyond Fund into Poweru, Zhonglufund into Kingeta, Softbank into Ecoso, Tiansu Fund into Sunwise and Aotianqi, SZVC into Jilin Keong, Yanwang into LuZhouDehan, Beijing Gongfa Group into Lampearl, etc." [404]

8. Targeted ESCO industry funds: China has also seen the establishment of both local government and private funds that can be used for EPC projects. In particular, the Shanghai Economic and Information Commission, the Shanghai Hongkou District Government, and private fund industry partners have worked together to develop the Special Energy and Environmental Industry Development Fund, which can finance EPC projects.[405]

As another example, in 2011, the company GFund management launched the first fully ESCO-focused fund in China. Its Phase One fund is 500 million RMB (about USD80 million). Scope of investment includes both direct investment in the equity of ESCOs and

[403]Meredydd Evans et al, 2015, op. cit.
[404]EMCA for IFC, 2013, op. cit.
[405]Meredydd Evans et al, 2015, op. cit.

investment in EPC projects. For projects, a minimum investment amount of 30 million RMB (about 5 million USD) is required, as well as return on investment (ROI) of 20 percent. If also given the opportunity to invest in the ESCO itself, Gfund may lower the ROI requirement for the EPC investment.[406]

3.4.3 Profiles of Specific Chinese Commercial Banks with Regard to ESCO Business

1. Bank of Beijing: In 2011, Bank of Beijing released its Energy Conservation Loan Product 2.0, whereby ESCO project loans can be secured mainly by project revenues. Loans can be issued for a maximum of five years. Loans may be secured by a combination of expected cash flows from ongoing projects, expected cash flow of the project being financed, and either one of or a combination of equipment, machinery, buildings and third-party guarantees. As of mid-2012, the Bank of Beijing had issued RMB1.8 billion (or about USD286 million) in energy saving loans. Of those, 17.8 percent are secured solely on the pledge of future account receivables. Another 30 percent use the pledge of a combination of future account receivables and traditional collateral. Minimum size of loans is RMB1 million (USD159,000); and the maximum is RMB100 million (USD15.9 million). For ESCOs with annual revenues of over RMB 100 million (USD15.9 million), an accounts receivable pledge alone can be used to secure the loan. Types of projects financed include waste heat recovery for power generation, building energy efficiency, energy recovery from flue gas, energy efficiency retrofits of the power industry, and energy efficient retrofitting of heating systems.[407]

2. Shanghai Pudong Development Bank: Shanghai Pudong Development Bank (SPD Bank) has developed a number of ESCO-related products. In 2010, it launched an ESCO receivables pledge product, whereby ESCO loans are guaranteed by expected project revenue flows. This product took advantage of loss sharing for bad loans that was provided by the IFC to stimulate innovative financing in energy efficiency. In 2011, SPD issued its ESCO factoring finance product. Its Shanghai branch has piloted these innovative ESCO products and issued over 100 loans in one year based on ESCO receivables pledge only. There is no requirement of mortgage or guarantee firm involvement. Loan term is up to five years.[408]

3. Pingan Bank: Formerly Shenzhen Development Bank, Pingan in 2012 launched its ESCO receivables loan product. ESCOs must be registered with NDRC or MOF or be a member of the Chinese ESCO association (EMCA) to qualify for these loans. ESCOs are also required to have implemented at least three EPC projects in the past. Further, the project to be financed must have the potential for verifiable energy savings and a contract period of less than five years. Finally, the ESCO must be providing at least 20 percent equity to the project.[409]

4. Industrial Bank Co., Ltd: Based in Fuzhou, Fujian Province, Industrial Bank Co. issued an ESCO product in 2012. The bank was the first in China to cooperate with IFC on energy

[406]EMCA for IFC, 2013, op. cit.
[407]EMCA for IFC, 2013, op. cit.
[408]EMCA for IFC, 2013, op. cit.
[409]EMCA for IFC, 2013, op. cit.

efficiency finance, which Industrial Bank Co. started to do in 2008. From 2006 through roughly 2012, the bank financed 60 EPC projects from about 50 ESCOs with total loan amount of about 1 billion RMB (about USD160 million). Its formalized product (mentioned above) was then officially launched in 2012. Interestingly, given its client base and access to information, Industrial Bank Co. has also launched a "value added" service for its ESCO clients, whereby it works to match the ESCOs with project opportunities. Industrial Bank Co. accepts project receivables as a pledge from ESCOs and provides them with both working capital loans and mid and long term loans. For the latter, the maximum term is five years. Industrial Bank Co. retains outside experts to assess energy efficiency projects, particularly with regard to their accounts receivables pledge and the qualifications of the ESCO involved. At present, ESCOs applying for these loans are required to have two years of experience. The contract amount of the project for which the loan is sought should be over RMB5 million (about USD794,000).[410]

[410]EMCA for IFC, 2013, op. cit.

4. Japan Case

4.1 Overall Japanese Market for ESPs and ESCOs

Japan is believed by many to be one of the countries in the world that has done the most to be energy efficient countries. Due to its lack of domestic energy resources, energy efficiency became a priority for Japan early on. In the early 1970s, Japan conducted study tours to the US, Canada, and Europe to understand best practice in energy efficiency.[411] Yet, Japan's ESCO market is relatively small compared to the US and China, the two countries with the world's largest ESCO markets. This is true even when the comparison of ESCO markets is made in proportion to GDP. Some analysts point out that, while Japan has one of the highest industrial energy efficiency levels in the world (particularly when energy intensity of individual heavy industry sectors are assessed), energy efficiency in its building sector is much less impressive. Most of the data obtained for this study focuses on the market of Japanese ESCOs, including both their performance-based business and non-performance based business. Yet, the small share of the ESCO business in the overall economy and Japan's very high levels of energy efficiency (at least in the industrial sector), imply that there are mechanisms other than ESCOs responsible for the nation's energy efficiency achievements. Non-ESCO ESPs, in particular large equipment vendors that may provide services with their equipment, appear to be one key mechanism. Another is the role played by internal energy managers, which are mandated by the Japanese Government for the most energy consuming companies.

Definition of ESCO in Japan and origins of Japanese ESCO market: Japanese sources reviewed for this study generally clearly note in their definition of ESCO that ESCOs are performance based. As Chiharu Murakoshi and Hidetoshi Nakagami (2009) point out, most Asian countries have developed their ESCO concept based on the US model, so that the definition of ESCOs in Asian countries is similar to that in the US.[412] Indeed, Japan's ESCO market was developed in the late 1990s, following the US model. Strong Japanese Government involvement from the start and policy support were key drivers.

Japan's ESCO and ESP market: The main source of data on Japan's ESCO market is JAESCO, Japan's association of ESCOs, which conducts surveys on the industry from time to time. The available estimates of Japan's ESCO market appear to be limited either to true ESCOs (that conduct at least part of their business via performance contracting) or to JAESCO members, of which only a subset is likely to be true ESCOs. The total ESCO market size estimates are based on all energy efficiency project business of companies defined as ESCOs. Thus, the estimates include both performance-based revenues and fee-for-service revenues. While sources indicate an ESCO contingent of 20 to 30 companies in Japan, the Japanese ESCO Association lists over 80 companies on its website, suggesting the definition of ESCO may at times not be strictly adhered to.

[411] Rod Janssen, personal communications, December 2015.
[412] Chiharu Murakoshi and Hidetoshi Nakagami, *Current State of ESCO Activities in Asia: ESCO industry Development Programs and Future Tasks in Asian Countries*, ECEEE 2009 Summer Study, 2009.

Some basic data on Japan's ESCO market size over the years is given in Exhibit 4-1. Historically, Japan's ESCO industry grew markedly between its initial setup in the late 1990s until 2003, in part due to strong government support. In 2003, the market of *performance based* projects reached a peaked of USD310 million and then began oscillating, reaching another peak (USD353 million) in 2007. The ESCO performance based project market dipped to USD101 million in 2009, in large part due to the financial crisis, and hit another peak of USD370 million in 2011. In 2008, the amount of performance based business of ESCOs had dropped from USD353 million in 2007 to 169 million.[413] This compares to an estimated USD3.1 billion market of performance based ESCO projects in the US in 2008.[414] Thus, considering the fluctuations in Japan, the US performance-based ESCO project market was perhaps in the range of nine to eighteen times that of Japan's at the time, though US GDP was only about three times that of Japan's in 2008.

Exhibit 4-1: Summary of Japanese ESCO Market Size Data (in USD)

Scope	2003	2006	2007	2008	2009	2011
ESCO Market	$310 million	$426 million	$554 million	$497 million	NA	NA
Performance based portion of ESCO market	NA	$229 million	$353 million	$169 million	$101 million	$370 million

Source: JAESCO market studies as quoted in Nakagami, 2010, op. cit., and in Murakoshi and Nakagami, 2009, op. cit.

Hidetoshi Nakagami (2010) indicates that, in 2007, the total Japanese ESCO market (including both performance-based and non-performance based projects of companies defined as ESCOs) was USD554 million, of which 353 million, or 63 percent, was performance based. In, 2008, the contraction of the overall market was just about eleven percent, but the share of performance based ESCO work in that market was only 34 percent. This is a drastic change from the previous year's 63 percent, suggesting clients and ESCOs decided that year to pursue fee-based work instead of performance based arrangements.[415] Yet, looking at 2007 as compared to 2006, which shows an overall year-on-year Japanese ESCO industry growth of 30 percent and performance based business growth of 54 percent, one can begin to get a feel for the up and down nature of the Japanese ESCO market and share of performance-based projects within that market.[416]

According to experts, the Japanese ESCO market did not advance much in the period of 2011 to 2013, as compared to 2008 to 2010, suggesting market stagnation. Analysts note that, after the major earthquake of March 11, 2011, in Japan and subsequent nuclear power plant accident, the Japanese Government required large facilities to decrease their peak weekday power consumption. Yet, associated efforts did not result in much new ESCO market activity.[417] Apparently, heightened energy efficiency efforts are being handled in other ways.

[413] Hidetoshi Nakagami Ph.D., *Recent Activity of the ESCO Industry in Japan and Asian Countries*, presentation at Asia ESCO Conference 2010, New Delhi.
[414]Andrew Satchwell et al., 2010, op. cit.
[415]Hidetoshi Nakagami, 2010, op. cit.
[416]Murakoshi and Nakagami, 2009, op. cit.
[417]Strahil Panev et al, *ESCO Market Report for Non-European Countries 2013*, EU Joint Research Center's Institute for Energy and Transport, 2014.

Recent estimates of Japan's overall energy efficiency and ESP market were not clearly apparent in the literature. As for the total potential exploitable ESCO market, earlier government work, when initially laying the groundwork for the industry in 1997, had estimated a total ESCO market size of USD22.5 billion in Japan.[418]

Sector breakdown of Japan's ESCO business: In the early stages of Japan's ESCO market, industrial projects predominated. Yet, after some time, building projects began to gain more and more share. This trend fits with analyses that suggest Japan's building sector is weak in energy efficiency, while its industrial sector is among the best in the world. The more efficient a sector, the more difficult to find "low-hanging fruit" with short payback periods. By 2008, in terms of the sectoral composition of all energy efficiency retrofits conducted by Japan's ESCOs (whether or not performance based), JAESCO data implies buildings were 75 percent of the market; and industry was 25 percent. This is down from a 41 percent share of industry in 2007.[419] As suggested in the changes in the data from 2006 to 2007 to 2008, the Japanese ESCO industry and thus the business of the involved ESCOs appear to be highly variable from year to year. At the same time, a downward trend in industry's share of the Japanese ESCO market and a rise in the building sector's share are clear.

Contract type and number and size of contracts: Shared savings contracts have been the most common in Japan's ESCO industry, after an initial period in which guaranteed savings contracts were popular. In 2007, shared savings contracts accounted for 54 percent of total performance based contract value in the Japanese ESCO industry. Energy outsourcing accounted for 36 percent, an increase from 21 percent the previous year. In 2007, there were 176 performance based ESCO contracts of all types, 107 in the commercial sector and 69 in the industrial sector. The average contract size that year was USD1.8 million in the commercial sector and USD2.3 million in the industrial sector. Both of these average contract sizes were up over 70 percent from the previous year. [420] By 2011, the balance appeared to have shifted back again in favor of guaranteed savings, with 159 of 214 contracts of that type. The largest average contract value that year, at 17.7 million USD, was for the contract category of energy supply and facility operation and maintenance. In comparison, EPCs that year had an average value of just USD1.7 million.[421] Yet, the growth of energy outsourcing is a newer trend in Japan. Historically, the bulk of Japan's ESCO performance based work done between 1998 and 2011 has been done via EPC. Over time, Japan's guaranteed savings contracts have had an average duration of about five years, whereas shared savings contracts have had average duration of ten years. Other categories of contracts have ranged from 12 to 14 years. For ESCO projects implemented to date in Japan, the payback period generally ranges from five to nine years.[422]

[418]Shirley Hansen, Pierre Langlois, and Paolo Bertoldi, *ESCOS around the World: Lessons Learned in 49 Countries*, 2009.
[419]Hidetoshi Nakagami, 2010, op. cit.
[420]Murakoshi and Nakagami, 2009, op. cit.
[421]Strahil Panev et al, JRC, 2014, op. cit.
[422]Strahil Panev et al, JRC, 2014, op. cit.

4.2 Japan Industrial ESP and ESCO Market

Evidence suggests that Japanese industry is among the most energy efficient in the world. Kimura (2011) notes that this is true for the most energy intensive industries and that the result is that there are few low-cost energy efficiency opportunities in Japanese industry. Kimura references studies from 2010 that show the fossil fuel power industry of Japan, its iron and steel sector, and its cement sector are all at levels giving them the lowest remaining "energy saving potential" in the world. The author notes, however, that the situation is quite different in non-energy intensive areas.[423]

Indeed, industry is very important to the Japanese economy; and the Japanese industrial sector has done quite well in energy efficiency. In Japan, the share of industry in the economy is about 43 percent, more than in most other developed economies, except for Germany where it is somewhat higher.[424] Japanese policy requires energy intensive factories to become one percent more energy efficient per year. Rob Schmitz, in discussing these improvements, references an interviewee who explains that everyone in the factory gets involved by tweaking the products and manufacturing processes. In this way, many individuals in the factory achieve small, incremental gains that add up to a lot of energy savings all together. Further, as mentioned, each major energy consuming factory must have at least one staff member who oversees energy efficiency.[425]

While the industrial sector is now accounting for a smaller share of Japan's ESCO market, to date industrial ESCO projects have made the majority of contributions to ESCO energy saving achievement in Japan. Looking at performance based ESCO project generated energy savings between 1998 and 2011, industrial energy savings accounted for 65 percent of the total. Of those 65 percentage points, 55 were achieved via shared savings and four via guaranteed savings.[426]

Business model of ESCOs in Japan's industrial sector: Of a total of USD227 million industrial sector ESCO business in Japan in 2007, USD65 million (29 percent) was non-performance based business. Further, in the industrial sector, energy outsourcing accounted for USD97.6 million (43 percent) of the ESCO market that year. The remainder of Japan's industrial ESCO market that year, or about USD64 million (28 percent), was mainly EPC.[427]

Type of ESCO projects in industry: Assessment of the most popular measures for industrial ESCO projects in Japan during the period 2002 to 2011 shows that installation of cogeneration plants is the most popular. That is, sources agree on the identification of cogeneration as a top area of ESCO work in the Japanese industrial sector. In terms of other top ESCO measures in Japanese industry, there is some variation among sources. According to one source, the other popular industrial sector ESCO measures during the 2002 and 2011

[423]Osamu Kimura, *Promoting Energy Efficiency in Industrial/Commercial Sector: Japanese Experience*, 2011.
[424]Shannon Bouton, et al, *Energy Efficiency: A Compelling Global Resource*, McKinsey, 2010.
[425]Rob Schmitz, "Industry Leads the Way," in the California Report, Oct. 5, 2009, accessed in Nov. 2015 at http://audio.californiareport.org/archive/R910050850/a .
[426]Strahil Panev et al, JRC, 2014, op. cit.
[427]Murakoshi and Nakagami, 2009, op. cit.

period, in declining order are: installation of inverter controls for air conditioning, efficient chillers, inverters for lighting systems, and LED.[428] According to another source, and based on a JAESCO survey in 2008, the most common types of projects after cogeneration (with the most popular listed first) include: pump and fans, freezer upgrading, lighting, boiler upgrading, and industrial processes.[429]

Achievement of ESCO projects: A JAESCO survey on Japan ESCO business from 2001 to 2007 determined average annual energy savings for different types of contracts in industry. For guaranteed savings (ten projects reviewed), the average annual energy savings was 8.9 percent. For shared savings (78 projects reviewed), the average annual energy savings was 13.8 percent. And, the average for industrial sector performance contracts was 12.7 percent annual energy savings (90 projects). For nonperformance contracts (34 projects), the average energy savings was 12.4 percent annually. Payback periods for industrial projects from 2001 to 2007 averaged as follows: 6.9 years for guaranteed savings projects (26 projects reviewed), 10.1 years for shared savings (28 projects reviews), 8.7 years average for performance contracts of all types (100 projects), and 6.9 years (53 projects) for non-performance based projects.[430]

Clients of industrial sector ESCOs: Clients of Japanese ESCOs in general and of industrial sector ESCOs in particular are mostly "blue chip clients." It appears that small and medium sized industrial enterprises are not a part of ESCO clientele and thus may require a different approach for reaching them.[431]

4.3 Japanese ESPs and ESCOs

Exhibit 4-2 below presents a list of members of the Japanese ESCO Association (JAESCO). A number of the names may be familiar to the reader as being among Japan's largest corporations. Japan's ESCO players show a predominance of large companies (or their subsidiaries), many of whom are equipment providers. It is likely that major equipment providers in general are also responsible for a great amount of ESP business in Japan not captured in the ESCO market statistics presented here.

Experts interviewed by the EU Joint Research Center (JRC) in 2012 and 2013 indicate that the Japanese ESCO market in 2011 had between 20 and 30 true ESCOs. The experts further indicated that this number has not changed much over the foregoing ten years.[432] As mentioned, the JAESCO website lists over eighty members. The group includes both utilities and ESCOs, though it seems likely that many companies that are not true ESCOs, but instead fee-based ESPs, are also among the members.

[428]Strahil Panev et al, JRC, 2014, op. cit.
[429]Hidetoshi Nakagami, 2010, op. cit.
[430]Hidetoshi Nakagami, 2010, op. cit.
[431]Murakoshi and Nakagami, 2009, op. cit.
[432]Strahil Panev et al, JRC, 2014, op. cit.

Exhibit 4-2: Members of Japan's ESCO Association (JAESCO)

Member Companies of Japan's ESCO Association	
ASAHI KOGYOSHA CO., LTD.	NIPPON STEEL & SUMIKIN ENGINEERING CO., LTD.
Azbil Corporation	Nishinippon Environmental Energy Company
Cenergy Co.	NTT FINANCE CORPORATION
Chiyoda System Technologies Corporation	Ogawa Shokai Corporation
Chubu Electric Power Co., Inc.	Oki Wintech Co., Ltd.
OGCTS Co., Ltd.	Onishi Shokai Co., Ltd.
DAI-DAN Co., Ltd.	Osaka Gas Co., Ltd.
DAIICHI KOGYO CO., LTD.	Pacific Consultants Co., Ltd.
Ecoairsolution Co., Ltd.	PLAZA CREATE CO., LTD.
Eijo Setsubi Kogyo Co., Ltd.	Ryoki Kogyo Co., Ltd.
Energia Solution & Service Co.	Ryuden Inc.
ERGOTECH CO., LTD.	Saibugas Co., Ltd.
Fujii Sangyo Corporation	SANKEN SETSUBI KOGYO CO., LTD.
Fuyo General Lease Co., Ltd.	SANK Engineering Co., LTD.
GUNZE ENGINEERING Co., Ltd.(Under Construction)	SATSUKIBARE. Co., Ltd.
Hasegawa Electric Industry Co., Ltd.	Shikoku Electric Power Co., Inc.
Hibiya Engineering, Ltd.	SINANEN CO., LTD
HIROSHIMA GAS Co., Ltd.	SHIN NIPPON AIR TECHNOLOGIES CO., LTD.
Hitachi Capital Corporation	Shintou Co. Ltd.
Hitachi, Ltd.	Shizuoka Gas Company Ltd.
Hokuriku Electric Power Company	Takasago Thermal Engineering Co., Ltd.
Japan Facility Solutions, Inc.	Technomirai, Inc.
Johnson Controls, Inc.	The Chugoku Electric Power Co., Inc.
KAKIMOTO CO. LTD.	The First Energy Service Co., Ltd.
KANDEN ENERGY SOLUTION CO., INC.	THE KANSAI ELECTRIC POWER CO., INC.
Kandenko	TOENEC CORPORATION
Keiyo Gas Co., Ltd.	Togami Electric Mfg. Co., Ltd.
Kinden Corporation	TOHO GAS Co., Ltd.
Kyudenko Corporation	Toho Gas Engineering Co., Ltd.
Kingrun Co., Ltd.	Tohoku Electric Power Co., Inc.
Koyo Electric Co., Ltd.	TOKYO GAS Co., Ltd.
Matsuo Kogyo Co., Ltd.	Tokyo Gas Engineering Solution Co., Ltd.
Mitsubishi Corporation	TONETS CORPORATION
Mitsubishi UFJ Lease & Finance Company Limited	TOSHIBA CORPORATION
MIURA CO., LTD.	Totech Corporation INC.
MIWA CO., LTD.	Trane Japan, Ltd.
MT Energy ＆ Solutions Co., Ltd.	YAMATO Inc.
Nakamura Co., Ltd.	Yashimakogyou Co.
NEC Capital Solutions Limited	Yokogawa Electric Corporation
Nihon Dengi Co., Ltd.	Yonden Energy Service Co., Ltd.
Nihon Kaihatsu Kosan Co., Ltd.	VEGLIA Laboratories
NIPPON KOEI CO., LTD.	

Source: JAESCO, list of member companies accessed in Nov. 2015 at http://www.jaesco.or.jp/english/ .

According to the experts interviewed by JAESCO, Japan's 20 to 30 true ESCOs are all private sector companies and most do not have energy efficiency services as their core business. The backgrounds of these companies include mainly building manufacturers, facility management and operation companies, consulting/engineering firms, equipment manufacturers, and suppliers or companies having energy supply as their main business. The group of true ESCOs are mainly Japanese companies, as it is difficult for foreign companies to start a business in Japan. The scope of business of these companies includes: provision of information and advice on energy efficiency investment opportunities, energy audits, implementation of energy efficiency measures, optimization and operation of implemented

solutions, and energy savings measurement and verification. The JRC found that JAESCO has 102 members.[433]

Profile of Hitachi ESCO: Hitachi entered the Japanese ESCO business in 1999. Eventually, Hitachi began to take its ESCO business overseas, focusing on Asia in particular. Interestingly, its first overseas ESCO contract was to provide a cogeneration system for Hitachi Global Storage Technologies Philippines Corp., part of a Hitachi joint venture in the Philippines.[434] Hitachi ESCO targets customers in both the industrial and commercial sectors. The ESCO explains that its focus is on reducing the "lifecycle operating cost" of energy-saving equipment. Its role, then, is to maintain the performance of energy saving equipment at the client over the period of the contract. Energy facilities they maintain mainly include co-generation machinery (e.g. gas turbine and gas engine), chiller equipment, and compressors. As machinery in the industrial sector often operates under severe conditions (i.e. year-round continuous operation), power output (performance) and efficiency may fall and the machine may malfunction. Hitachi ESCO addresses the challenging situation of monitoring each facility it is responsible for and determining when there is degradation. It is difficult to detect degradation, as the demand on some equipment is constantly changing. Yet, assessment of that deterioration is a key part of their work. Two of Hitachi's main functions, then, are to: (1) monitor and evaluate performance of major equipment (e.g. a gas turbine, refrigeration equipment) and (2) optimize operation of complex equipment.[435]

4.4 Drivers of and Barriers to Japan ESP and ESCO Market

Energy costs and policy have been the major drivers of energy efficiency efforts in Japan, including the ESP and ESCO markets. Policy and costs, in turn, are driven by Japan's high import-dependence in the energy sector. The energy market situation in Japan following the major earthquake of March 2011 is considered a more recent market driver. While high energy prices have been an ongoing driver in Japan, this new situation has intensified efficiency targets. Other drivers include benefits to clients in working with an ESCO: transferring equipment maintenance risks to the ESCO, reducing the possibility of blackouts, outsourcing of energy supply, reducing the size of company assets, and the potential to reduce operation and maintenance costs.[436]

Japanese Government policy and programs: The Japanese Government played a critical and very specific role in the launch of the nation's ESCO industry. In 1996, the government commissioned an investigation on the potential of ESCOs in Japan. In 1997, they organized a more in-depth feasibility study, involving 223 persons from 208 organizations. In 1998, NEDO (Japan's New Energy and Industrial Technology Development Organization) carried out four building sector ESCO demonstrations. The government also developed a standard contract. In 1999 to 2002, work was done on monitoring and verification, taking up the US-

[433]Strahil Panev et al, JRC, 2014, op. cit.
[434] Japan for Sustainability website, 2006 article, accessed in Nov. 2015 at: http://www.japanfs.org/en/news/archives/news_id026208.html.
[435]Masaaki Bannai et al, *Energy Solutions in the Industrial and Commercial Sectors*, Hitachi, 2008.
[436]Strahil Panev et al, JRC, 2014, op. cit.

developed IPVMP system and adjusting it to the case of Japan. Insights for adjusting the system to the Japanese case were obtained via surveys of mainly commercial facilities.[437]

Japan's Rational Use of Energy Act, first issued in 1979 and amended several times since has been a major driver in improving the energy efficiency of the nation's largest energy intensive industrial firms. An amendment to the Act (2008) has set specific and mandatory benchmarks for the sectors of steel, electricity, cement, pulp and paper, oil refining, and chemicals. Targets were initially set on the basis of the top performers in energy efficiency in each sector (the top ten to 20 percent) and are to be met in 2015 and 2020. The benchmarks are negotiated between industry and government before being adopted. [438] As Shiel et al (2011) note when referring to previous efforts under the Act, the policy's very sharp focus on the industrial sector has resulted in "one-sided" success. Industry's total energy consumption in Japan has remained flat in recent years, even though output has gone up. And, thus, industry's share in Japan's total energy use has gone down, as the shares of the building and transport sectors have gone up. It was this act that required certain large industrial energy users to appoint internal energy managers and record energy utilization. Initially in 1979, 3,000 factories were designated to comply with this requirement. Examinations and a training scheme for the energy managers was launched in 1983. A streamlined process for licensing and approval of the energy managers was developed in 1984.[439] The firms closely regulated in these ways now number around 14,000 and are mainly industrial sector firms. Kimura's analysis (2011) suggests the policy has been effective among these regulated firms.[440] Panev et al of the JRC (2014) note that the Act has been supported by a loan program with special interest rates for companies undertaking energy efficiency projects. It has further been supported by tax exemptions and special depreciations for SMEs purchasing energy efficient equipment. The JRC's expert interviews confirm the impression that the Act and these various measures have been effective in promoting the energy efficiency market and ESCOs.[441] Low-interest loans are available for the purchase, for example, of cogeneration systems.[442]

In addition to its "enforced self-regulation" or "management-based regulation" via the required energy manager system, the Japanese Government has also provided much energy efficiency information and education to industry, such as guidelines, manuals, training and audits. The audits are one area that has been applied to both small and large industrial companies. The audits have been provided free of charge via government support. These government provided audits are managed by government agencies, including ECCJ (Energy Conservation Center of Japan) and NEDO (New Energy and Industrial Technology Development Organization). ECCJ's program carries out 300 to 1,000 audits annually in SMEs, while NEDO's program, from 1999 to 2007, provided 40 to 100 audits per year to

[437]Shirley Hansen et al, 2009, op. cit.
[438]Industrial Energy Efficiency Policy Database: "JP-3: Mandatory Energy Efficiency Benchmarking in Industry," accessed in Nov. 2015 at http://iepd.iipnetwork.org/policy/mandatory-energy-efficiency-benchmarking-industry .
[439]Patrick Shiel, Nick Jeffers, Mark Dyar, *Energy Conservation Measures in Japan*, Trinity College Dublin, 2011.
[440]Osamu Kimura, 2011, op. cit.
[441]Strahil Panev et al, JRC, 2014, op. cit.
[442]ABB, Japan Energy Efficiency Report, 2011.

large facilities. Interestingly, most audits were provided to companies in non-energy intensive sectors, as these did not have the needed energy expertise in house. Also of interest, most of the recommendations do not require investment. They are operational improvements, suggesting the audits most importantly served as an "awareness tool." Some measures requiring investment are included, but these have short payback periods (generally less than three years). According to Kimura, cost benefit analysis has shown the audit programs to be cost-effective, on a similar level to such programs being carried out in the US and elsewhere.[443]

Barriers to ESCO market development in Japan: Experts interviewed by the JRC in 2012 and 2013 indicate a number of barriers to ESCO market development in Japan. One is challenging economic conditions and the concern that clients may not be around long-term. Complex public procurement rules, another barrier, hinder the expansion of the ESCO building market in the public sector. A number of other barriers are similar to those found in other countries: Potential ESCO clients may have concern that the energy efficiency measures will negatively impact their business and usually also put low priority on energy efficiency. Also, lack of good baseline data from which to determine energy savings for EPCs is a problem. Lastly, commercial banks do not have suitable knowledge of and loan products for ESCOs.[444]

4.5 Financing in Japan's ESCO Market

Common means of financing ESCO projects in Japan include client internal funds and financial leases by commercial banks. For some projects, Japanese ESCOs finance projects with their own funds (both equity and corporate debt). Yet, while this allows them to act quickly, it increases their exposure to risks associated with their client. In Japan, some ESCOs work with financial leasing companies to finance their projects.[445]

[443]Osamu Kimura, 2011, op. cit.
[444]Strahil Panev et al, JRC, 2014, op. cit.
[445]Strahil Panev et al, JRC, 2014, op. cit.

5. Ukraine, Thailand, and Korea
Selected based on Strong Role/Potential of Industry in Overall ESP Market

5.1 Ukraine

The case of the Ukrainian ESP market is of interest as a less developed ESP market in which the industrial sector plays a major role and has a major need for energy efficiency services. Ukraine's ESPs have experienced a lot of ups and downs with the market, since efforts were first made to promote them in the late 1990s. Their history sheds light on the challenges of building an ESP sector. Further, it is interesting to note that many of Ukraine's ESPs are small, energy audit-focused firms. Indeed, EPC has not taken hold in Ukraine. Instead, most of these companies, while called "ESCOs," are providing audits on a fee-for-service basis. For those ESCO performance based contracts that do occur, the BOOT model, in which energy services such as district heating are provided, is the predominant contract type. Financing is a key barrier to the development of true ESCOs and EPC in Ukraine. To date, much of the true ESCO industry in Ukraine has been driven by donor projects. In general, the ESCO/ESP market in Ukraine is still not that developed, though the first ten ESPs were established in 1996 to 1997. Today, there are about 30 of these companies.[446]

Overall Ukrainian ESP Market: Sources uniformly suggest the great potential of Ukraine's energy efficiency market, given the low level of efficiency in industry and buildings today. No estimate of the realized market for ESPs, or for the ESCO subset, was identified in the literature. An estimate of the market potential for ESCOs of €100 million is provided by the EU's JRC.[447] Sources suggest that the institutional environment in Ukraine has been a constraining force to releasing the potential of the ESP and ESCO markets. Lack of access to financing, as in many other countries, has also been a key barrier.

Ukraine has been pursuing the "ESCO" concept, albeit mostly through non-ESCO ESPs, since it was first introduced in Kiev, Ukraine, via lectures sponsored by the US Agency for International Development (USAID) in 1996. Today, Ukraine continues to have a high level of energy inefficiency, with "millions of old engines as well as hundreds of thousands of energy-inefficient pumps, boilers and compressors" still in operation today. In 2011, it was estimated that only seven percent of the nation's industrial assets had undergone energy efficiency upgrades over the foregoing 15 years and that only three percent of utilities had done so during that period.[448]

Energy dependence on imports in Ukraine is quite high, as 70 percent of natural gas and half of oil consumed are imported. As such, energy efficiency is a high national priority. Industry, residential buildings, utilities, and the power sector have relatively low energy

[446]Paolo Bertoldi et al, *European ESCO Market Report 2013* EU Joint Research Center's Institute for Energy and Transport, 2014.
[447]Paolo Bertoldi et al., 2014, op. cit.
[448]Vasily Stepanenko, *Report for ESCOs in Ukraine*, 2012.

efficiency ratings and thus high potential for short payback period energy efficiency projects. The energy intensity of the Ukrainian economy is about four times of that as the EU 28.[449]

Sectors: The main client sectors for Ukraine's ESPs are industry and municipal heating systems.[450] Most recently, increasing attention has been put on heating, water supply, and public buildings. These have been receiving the greatest attention from the Ukrainian Government lately. Projects in the building and municipal heat supply sectors also appear to be attracting the most attention from donors, which are a major force in the market.[451] At the same time, the great need for energy efficiency in the industrial sector remains.

Business model: Ukrainian ESPs have not developed expertise in third party finance. Also, they are not doing EPC. For one, EPC does not fit in with the existing situation of contract rights in Ukraine. Further, bank lending rates tend to be too high to make this business model profitable. Instead, the main business model is "direct services contracts." On occasion, trade credit and leasing are used. Guaranteed savings contracts are not popular.[452] As far as true (performance-based) ESCO projects are concerned, the main business model is BOOT. Overall, however, energy auditing on a fee-for-service basis is the main basic service provided by Ukrainian ESPs. Demand for audits is high in both industry and the building sector. Revenues from audits are relatively low, but they are believed to play an important role in the development of a true ESCO market.[453]

Ukrainian Industrial Sector ESP Market: The main types of energy efficiency projects implemented in Ukraine's industrial sector with the help of ESPs are: (1) improvement and reconstruction of heat supply systems, (2) reconstruction and modernization of compressed air production systems, (3) modernization of pump stations, (4) industrial process optimization, and (5) construction of cogeneration projects. Much less common are occasional projects in: (6) improvement of installation for industrial cooling and (7) waste heat recovery.[454]

Ukrainian ESPs: While over 120 companies are registered in Ukraine to carry out simple energy audits, about 30 companies have the capability of carrying out full energy audits. Less than ten companies have the capability of conducting a fuller range of activities that may be associated with a full ESCO. Most of the current, active 30 ESPs are small and privately owned, though there are also among them several large companies owned either by local government or state-owned enterprises.[455]

Vasily Stepanenko (2012) has tracked the ups and downs of Ukrainian ESPs, since the first ten or so were set up in the Ukraine in 1997, stimulated by a USAID program. This first group of ESPs (called "ESCOs") were small regional companies focused on energy savings. They were typically small engineering firms with annual revenue of less than USD200,000

[449]Paolo Bertoldi et al., 2014, op. cit.
[450]Pierre Langlois and Shirley Hansen, *World ESCO Outlook*, 2013.
[451]Vasily Stepanenko, 2012, op. cit.
[452]Langlois and Hansen, 2013, op. cit.
[453]Vasily Stepanenko, 2012, op. cit.
[454]Vasily Stepanenko, 2012, op. cit.
[455]Paolo Bertoldi et al, 2014, op. cit.

each. They lacked working capital and the ability to gain the trust of Ukrainian industry, which was their main potential market. In 1998, a state-owned ESCO ("UkrESCO") was established under a European Bank for Reconstruction and Development (EBRD) project, receiving a USD26 million loan. In 1999, five ESCOs established an association ("AESKO"). Membership grew to 37 members, but eventually (around 2004) the association ceased to exist.[456]

The period between 2000 and 2005 saw privatization in Ukraine's industry and energy sectors, thus leading to a new interest in energy efficiency. The nature of projects changed from low-cost energy initiatives, to more capital-intensive, medium-term projects. The number of ESP contracts grew and the size of the contracts increased. Customers became more discriminating in terms of quality of ESP work. As a result, the industry consolidated, to some extent, with a number of ESPs going bankrupt and small "ESCOs" merging into larger ones. By the end of this period, 2005, there were about 30 to 40 ESPs in Ukraine.[457]

From 2005 to 2008, massive increases in energy prices (25 to 45 percent per year), led to increased demand for energy efficiency and a need to move from the low-cost approach to initiatives on a greater scale. The number of ESPs rose to 70 to 80 companies. During this period, energy efficiency projects worth millions of dollars were implemented in the country. And, the largest demand was from energy intensive sectors, including metallurgy and mining, food products, chemicals, buildings, and the public sector. Given the demand for more capital intensive projects, the Institute for Energy Savings and the Environment (led by a former Ukrainian Energy Minister) established Ukraine's first finance-oriented ESCO ("Donbas's Industrial Union"). It carried out large energy efficiency projects for metallurgical plants.[458]

From 2008 to 2010, another wave occurred in the Ukrainian ESP industry. At this time, the financial crisis wreaked havoc on the industry. Most large and medium projects were stopped or eliminated, as investment left the country and construction halted across the country. As with companies in other sectors, many ESPs went bankrupt. By 2010, only about 20 ESPs had survived. Yet, by 2011, the Ukrainian ESP sector began to thrive again; and, with it, the number of ESPs grew. At this point, emphasis in the sector shifted from industry to municipal energy and public buildings. Due to huge price increases in energy over the preceding five years, the demand for ESP services grew substantially and continues to grow.[459]

Audit capabilities: As mentioned, energy audits are the main basic service of Ukrainian ESPs; and there is a great demand for these. As of 2012, about 120 companies were registered to offer simple audits (termed by Stepanenko as "express and demonstration audits"). These companies are mostly quite small, often with only one employee. The audits are low-cost, but useful in describing energy losses and assessing financial implications. At present, full energy audits are also available, with about 30 companies having the capability to do these. Such audits are usually carried out before ownership changes hand. Lastly, investment grade audits are even more complex and done before major modernization projects are implemented. Reports

[456]Vasily Stepanenko, 2012, op. cit.
[457]Vasily Stepanenko, 2012, op. cit.
[458]Vasily Stepanenko, 2012, op. cit.
[459]Vasily Stepanenko, 2012, op. cit.

generated as a result of these audits include business plans and detailed design for their implementation. These kind of audits require more specialized skills and sometimes specialized (and expensive) equipment. Other ESP services arising in recent years include "energy modernization strategies" for industries, municipalities, and heat and water supply companies. Yet, there are only about ten ESPs in Ukraine that have capabilities to provide all of the aforementioned services.[460]

ESCO Associations: Like the ESCOs themselves, efforts at establishing ESCO associations in the Ukraine have suffered ups and downs. As mentioned, the first Ukrainian ESCO association, established in 1999, closed down about five years later. The purpose of this first association had been to promote better cooperation between private ESPs, the public sector, financial institutions, and the business sector.[461] In 2009, efforts were made to set up the Association of Ukrainian Energy Auditing Companies. Yet, the efforts were largely unsuccessful. By 2012, only a few members remained.[462] In 2013, yet another association was set up, this one established by six companies. The main objective of the new association is to use the true ESCO model to initiate municipal and regional projects.[463]

ESP Workforce Training: Since 2006, a number of Ukrainian institutions of higher learning have been training energy managers and energy auditors. Demand for these professions in Ukraine is growing. Thus, these developments in the education sector are a positive force for the ESP industry.[464]

Drivers and Barriers of Ukrainian ESP and ESCO Markets: Key drivers of Ukraine's ESP and ESCO markets are: (1) low energy efficiency levels in industry and buildings and the associated "low hanging fruit" of fast payback projects; (2) high energy prices and dependence on imports for a large share of fossil fuels; (3) ISO 50001; and (4) international donor activity. Another area, (5) government policy, plays a role as a driver, but also as a constraint, as more supporting legislation is needed to enable a market with EPC. Stepanenko (2012) discusses the potential of international standards for energy management (ISO50001) as future driver of Ukraine's ESCO market. He suggests that the standards will change the quality control systems of thousands of Ukrainian companies and that ESCOs could assist with implementing these changes.[465]

Donor activity: Since USAID's initial introduction of the ESCO concept to the Ukraine in the late 1990s, donors have been active in promoting ESPs and ESCOs in the nation. The most recent donor activity appears to be focused more on building and district heating ESCO projects, rather than on the industrial sector. An interesting example of a donor project related to ESPs in the industrial sector is one that was carried out by US nonprofit, the Alliance to Save Energy. The project is entitled *Ukraine Industrial Energy Efficiency Initiative*. The project produced 14 feasibility studies for Ukrainian industrial facilities based on the outcomes of energy audits performed by Ukrainian ESPs. One of the projects calls for the

[460]Langlois and Hansen, 2013, op. cit.
[461]Paolo Bertoldi et al, 2014, op. cit.
[462]Vasily Stepanenko, 2012, op. cit.
[463]Paolo Bertoldi et al, 2014, op. cit.
[464]Vasily Stepanenko, 2012, op. cit.
[465]Vasily Stepanenko, 2012, op. cit.

replacement of a building material factory's natural gas-fired boiler by a new boiler using wood waste fuel. The Export-Import Bank of Ukraine has already approved this project for financing. The Alliance to Save Energy project is also promoting partnerships to carry out future projects. In a trade mission, the Alliance introduced US, Canadian, and European ESCOs and energy efficiency manufactures to Ukrainian manufacturers, banks, and ESCOs. The Alliance reported in 2008 that four partnerships and two confirmed joint ventures had been established as a result of the mission. The joint ventures received USAID funding to set up shop in the Ukraine and carry out their first two energy efficiency projects.[466]

Policy environment: While there have been some recent government initiatives to promote building and district heating ESCO projects, the slow pace of achieving policy support for energy efficiency tends to put a drag on ESP development in Ukraine. Frequent changes in government have made it difficult to promote and achieve desired policy initiatives. At the same time, Ukraine, like Turkey, is a member of the Energy Charter Treaty (ECT). As such, it is obliged to adopt EU legislation in the field of energy savings, energy services, and energy efficiency. Ukraine's efforts in this regard are ongoing.[467]

Better ESCO policy is need to attract more investment into energy efficiency initiatives. Currently, the ESCO business model is not recognized by authorities in Ukraine. Instead, they accept only contracts for such companies to deliver goods or consulting services, rather than a full ESCO "package." As ESCO contracts are not in line with national regulations, there is a need for the government to develop a standard EPC contract.[468]

In 2013, two draft version of a law on ESCOs were submitted to the Ukrainian Parliament. The law is focused on ESCO activity in the public and municipal sector, especially related to building renovation. The law is expected to stimulate the building sector market for Ukrainian ESCOs.[469]

Financing of ESCO and ESP projects: Perhaps the biggest barrier for moving the Ukrainian ESP industry beyond a focus on audits is the lack of financing for energy efficiency projects generally and the lack of financing for ESCO structured projects in particular. The commercial banks lack experience with ESCO projects and financial products specifically designed for these. As mentioned, Ukrainian ESCOs/ESPs are not yet knowledgeable about providing third-party financing to projects. Further, commercial bank interest rates are quite high. Thus, direct service contracts are the commonly used vehicle for ESP services, with some leasing and trade credit also utilized at times.[470]

Donor loans from international financial institutions, such as the EBRD, IFC, GEF, and World Bank, and distributed via commercial banks have been used to finance energy efficiency projects in Ukraine. One example is the Ukraine Energy Efficiency Program (UKEEP), a credit facility developed by EBRD. It provides debt financing to private SMEs

[466] Alliance to Save Energy, "Industrious Ukraine," May 29, 2008 accessed in November 2015 at https://www.ase.org/resources/industrious-ukraine .
[467]Paolo Bertoldi et al, 2014, op. cit.
[468]Paolo Bertoldi et al, 2014, op. cit.
[469]Paolo Bertoldi et al, 2014, op. cit.
[470]Vasily Stepanenko, 2012, op. cit.

for industrial energy efficiency and renewable energy projects. Only privately owned companies are eligible. Loans could be up to USD2.5 to 3.0 million each. Between 2007 and January 2013, 75 projects were approved with total loan amount of 112 million USD. Common projects financed include: rehabilitation of boilers, replacement of old gas boilers with condensing boilers, switching from electrical heating to fuel based district heating, energy management systems or building management systems, etc.[471]

The Alliance to Save Energy, through its industrial energy efficiency project in the Ukraine, aimed to stimulate financing for identified projects. Their strategy was to provide high quality feasibility reports with international authorship, following audits provided by Ukrainian ESCOs. They believed that the high international standard reports would enable the banks to see the projects as "bankable" and worthy of investment, thus helping to overcome the financing barrier to ESCO projects in Ukraine.[472]

Other barriers: Other barriers to the development of the ESP and ESCO market in Ukraine include: (1) lack of reliable data (whether in industry or the residential sector) with which to establish an ESCO project baseline; (2) lack of skills in the industrial sector to carry out recommended technical options to increase energy efficiency; and (3) general economic turmoil.[473]

[471]Paolo Bertoldi et al, 2014, op. cit.
[472]Alliance to Save Energy, 2008, op. cit.
[473]Paolo Bertoldi et al, 2014, op. cit. and personal communication with Rod Janssen, Dec. 2015, op. cit.

5.2 Thailand

Thailand presents an interesting case as a developing country that has been able to achieve a substantial scale ESP/ ESCO market that is predominately operating in the industrial sector. Key drivers have been strong government policy and financing support, as well as the involvement of donors. Government and donor support continue at present to play a substantial role. The EU's JRC suggests that Thailand is one of two countries in Asia where the ESCO market is most developed relative to existing market potential.[474] Sources suggest a clear definition of ESCO in Thailand as compared to ESPs more generally in that ESCOs guarantee savings and may participate in financing. A presenter from Thailand's ESCO Information Center (under its Ministry of Energy) indicates that both energy consultants and ESCOs: (1) monitor and analyze energy consumption; (2) prepare engineering design; and (3) supply and install equipment, but that only ESCOs (5) serve as a source of funds and (6) guarantee savings.[475] Yet, at the same time, analysts acknowledge that the majority of "ESCOs" in Thailand are not yet involved in contracts in which they guarantee savings.

Overall Thai ESP and ESCO Market: According to the JRC, Thailand is estimated to have had about USD445 million in revenues generated by energy efficiency investments in 2012. Of that, investments related to ESCO projects or similar work of energy consulting firms is estimated at 100 to 200 million USD in 2012. The estimated market potential for ESCOs and energy consulting firms for the same year was about USD500 million. Thailand's ESCO/ energy consulting market shows a growing trend, though does experiences up and downs, contracting from 2008 to 2010 with the world economic crisis. From 2011, the market starting increasing again.[476] Another source, writing in 2015, has estimated the Thai ESCO/ energy consulting market at USD150 million per year, with about 300 projects per year, thus implying an average project size of USD500,000.[477]

Sector and focus: The vast majority of business in the Thai ESCO/ energy consulting market is in the industrial sector. ESCO/ ESP activities in the commercial and public sectors are quite limited. For 2009 to 2011, during which there were said to be 302 ESCO/ ESP contracts, 94 percent of total contract value was in the industrial sector and six percent in the commercial/ building sector.[478] Within the building sector, there is some activity, in particular, in hospitals and central government buildings. For the latter, the ministries have tended to use a government fund for ESCO projects ("EERE") to support EPC projects in their own buildings.[479]

[474]Strahil Panev et al, *ESCO Market Report for Non-European Countries 2013*, EU Joint Research Center's Institute for Energy and Transport, 2014.
[475]Thai ESCO Information Center, Department of Alternative Energy Development and Efficiency, Department of Energy, Thailand, Presentation: *Development, Creating, and Enabling Environment for ESCO: Thailand's Experiences*, 2012.
[476]Strahil Panev et al, JRC, 2014, op. cit.
[477]Verena Streitferdt and Christopher Seeley, *ESCO Market Study*, presentation at Roundtable Workshop on Financial Mechanisms to Transform the ESCO Market in Thailand: Discussion of the NAMA Proposal, June 25, 2015.
[478]Thai ESCO Information Center, 2012, op. cit.
[479]Strahil Panev et al, JRC, 2014, op. cit.

Business model: The projects in the Thai ESCO/ energy consulting market are dominated by fee-for-service arrangements rather than EPC. For contracts that are actually performance based, guaranteed savings contracts and BOOT (energy services) contracts are the main types. It is not common for ESCOs to finance projects.[480] It is the larger projects that use energy performance contracting. These are also likely the projects that require more funding from government and donor funding mechanisms. These projects tend to be more complex and require detailed risk assessment and management.[481]

Thai Industrial Sector ESP and ESCO Market: As mentioned, the vast majority of Thailand's energy consulting and ESCO projects are in the industrial sector. Below, the type of projects, the type of potential clients, and a few sample projects are reviewed.

Type and scale of projects: Typical technologies and areas of application of ESP/ ESCO projects to date in the Thai industrial sector include: pumps, electric motors and inverters, CHP, lighting, and air conditioning. Further, for the future, energy efficiency improvement actions in industrial processes is considered an area of promising business potential.[482] Small projects in the range of USD150,000 to USD1.3 million account for the majority of investment. These small projects are typically related to areas such as boiler and chiller replacement, heat pump installation, and energy management systems. Large projects ranging from USD3.2 million to USD32.3 million include installation of CHP plants, waste energy recovery, and generation of energy from renewables. Experts suggest that the Thai ESCO market should move to larger and more complex projects. This could increase overall investment levels and utilization of performance based contracts, but will also present challenges in terms of qualified personnel, suitable methods of measurement and verification of energy savings, and trust levels of clients.[483]

Industrial sectors with strong potential for ESP/ESCO projects: According to data presented by Verena Streitferdt and Christopher Seeley (2015), the top five Thai manufacturing industries in terms of investment potential for energy efficiency projects implemented by ESPs and ESCOs are: (1) food products and beverages, (2) motor vehicles and semitrailers, (3) textiles, (4) chemicals, and (5) nonmetallic minerals.[484]

Sample projects: Exhibit 5-1 summarizes some ESP/ ESCO projects that have been implemented in Thailand to date.

[480]Verena Streitferdt and Christopher Seeley, 2015, op. cit.
[481]Strahil Panev et al, JRC, 2014, op. cit.
[482]Strahil Panev et al, JRC, 2014, op. cit.
[483]Strahil Panev et al, JRC, 2014, op. cit.
[484]Verena Streitferdt and Christopher Seeley, 2015, op. cit.

Exhibit 5-1: Samples of Industrial ESP/ ESCO Projects Implemented in Thailand to Date

Thai Yamaha Motor Co., Ltd. **Air Compressor DMS**	**Bangkok Produce Merchandizing (Saraburi)** **Cogeneration Power Plant**
Type of business: Factory *Technology*: Air compressor demand side management system (ACDMS) *Type of EPC*: Guaranteed savings *Investment*: USD124,000 *Average electricity savings*: 1.32 GWh/year *Cost savings*: USD112,000 *Payback period*: 1.16 years	*Technology*: Cogeneration power plant, 4.5 MW, 12 TPH, gas turbine generator (GTG) (fuel: natural gas) *Investment*: USD4.84 million *Energy cost savings*: USD1.24 million/year *Payback period*: 4.95 years *IRR*: 20% *Year*: 2002 (World Bank pilot project) *Location*: Saraburi *Financing*: Energy audit of USD150,000 paid with GEF grant; project costs of 4.84 million USD borne by factory with help of low interest EERF loan for 30% of investment amount
Saw Mill **Cogeneration Power Plant**	**Pataya Food Industries** **Low Pressure Boiler**
Technology: Cogeneration power plant 5.2 MW, 3.4 TPH, gasification + gas Engine (fuel: biomass) *Investment*: 10.71 million USD *Energy cost savings*: 2.36 million USD/year *Payback period*: 4.8 years *IRR (15 Years)*: 19.6 % *NPV (15 Year DR@6.5%):* 10.27 million USD *Year savings began*: 2013 *Location*: Trang	*Technology*: Low pressure boiler 15 TPH (fuel: solid fuel) *Investment*: 2.24 million USD *Energy cost savings*: 736,000 USD *Payback period*: 3 years *IRR (15 Years):* 34.74 % *NPV (@ 8% discount rate):* 5.38 million USD *Year savings began*: 2012 *Location*: Bangkok

Sources: Thai Yamaha case: Thai ESCO Information Center, 2012, op. cit.; saw mill and Pataya Foods cases: Arthit Vechakij, *Thai ESCO Association & ESCO Business Model*, presentation at Inter-regional Workshop on Energy Efficiency Investment Projects Pipeline at UNCC, April 24, 2014; Bangkok Produce case: Vechakij, 2014, op. cit. and Murakoshi and Hidetoshi Nakagami, 2009, op. cit.

Thai ESPs/ESCOs: The number and nature of Thai energy consulting companies and ESCOs are discussed below. The type of work they do, the issues they face, and their association and promotion are also discussed.

Number of Thai ESPs/ESCOs: There are about 45 energy consulting firms/ ESCOs officially registered with the Federation of Thai Industry (FTI). Of these, about 37 were believed to be active in 2012. Only ten conducted performance based work; and this number of firms has not changed much over the past decade. The rest of the registered firms may be more accurately described as ESPs generally or energy consulting firms.[485] One source reports that there are more active "ESCO" companies than registered ones, perhaps 60 in total.[486] And, another source reports a total of 50 to 200 ESCOs/ESPs as of 2015.[487]

[485]Strahil Panev et al, JRC, 2014, op. cit.
[486]Thai ESCO Information Center, 2012, op. cit.
[487]Verena Streitferdt and Christopher Seeley, 2015, op. cit.

Nature of Thai ESPs/ ESCOs: The 45 ESPs/ESCOs registered in Thailand are mainly domestic Thai companies.[488] One source, however, reports that there are about ten foreign companies among the registered ones. The foreign ESCOs/ ESPs come from the US, UK, Japan, France, Australia, and Korea.[489] According to another source, Japanese trading companies initially entered the Thai ESCO market in 2007 in hopes of serving the many Japanese manufacturing subsidiaries in Thailand. Interestingly, the Japanese trading company ESCO subsidiaries were not successful and left the market, though later Thai indigenous ESCOs were able to successfully land projects with Japanese manufacturing subsidiaries in Thailand.[490] Many of the ESCOs/ ESPs in Thailand are manufacturers and suppliers of technologies like heat pumps, variable speed drives, lighting systems, and systems for ventilation and air conditioning. These equipment-focused ESPs/ESCOs may be (1) the manufacturers of the equipment or, instead, (2) agents or suppliers of the equipment, experienced in installation and maintenance. The third type of ESCO/ ESP in Thailand is (3) the energy consulting firm, generally a small company. Indeed, Thai ESCOs/ ESPs appear to come in a range of sizes from very small to quite large. Twenty-five to 50 percent of Thailand's ESCOs/ ESPs are small companies with fewer than 50 employees. In contrast to them, the larger ESCOs usually do not have energy services as their core business. Instead, they are most often manufacturers of products such as lighting systems and insulation materials.[491]

Function of Thai ESPs/ ESCOs: Thai ESPs/ ESCOs as a group cover the full value chain of energy efficiency services. Yet, the number of firms that can conduct all of the relevant activities is quite limited. Areas of work include: identification of measures to be implemented, technical planning, identification of third party financers if needed, implementation of energy efficiency measures, operations and maintenance of installed equipment, and (a more limited group) monitoring and verification (working with in-house professionals).[492]

Issues faced by Thai ESCOs/ESPs: Some of the issues faced by Thai ESCOs /ESPs include: (1) New companies with lack of experience in the sector may hurt the reputation of the whole group by doing bad work. (2) ESCOs/ ESPs may have difficulties in carrying out timely operation and maintenance due to most of the energy efficiency technologies being imported. (3) Personnel of the ESCOs/ ESPs may not have the needed competencies due to lack of sufficient attention by management in recruiting. This may be particularly true when energy services are not the company's core business and there is thus a lack of attention to such services within the firm. This, like the first item, leads to lack of confidence among customers.[493]

ESCO association and promotion of ESCOs: An "ESCO" association was set up under the Federation of Thai Industries (FTI) in 2012, though FTI had also played a role in promoting

[488]Strahil Panev et al, JRC, 2014, op. cit.
[489]Thai ESCO Information Center, 2012, op. cit.
[490]Chiharu Murakoshi and Hidetoshi Nakagami, *Current State of ESCO Activities in Asia: ESCO industry Development Programs and Future Tasks in Asian Countries*, ECEEE 2009 Summer Study, 2009.
[491]Strahil Panev et al, JRC, 2014, op. cit.
[492]Strahil Panev et al, JRC, 2014, op. cit.
[493]Strahil Panev et al, JRC, 2014, op. cit.

ESCOs prior to this time. An information center ("Thai ESCO Information Center") has been created by FTI with the support of the government and the association. The purpose of the center is to facilitate exchange among "ESCOs," financing institutions, and ESCO clients. FTI has established an annual award for the best implementers of ESCO projects and organizes annual trade meetings for the industry. In general, efforts to promote the industry involve FTI, the association, and the relevant government department. [494]

Drivers and Barriers of Thai ESCO market: Key drivers of the Thai ESCO and ESP markets include government policy and programs, donor projects, the large potential for energy efficiency improvements, energy prices, and the demonstration effect of successful projects to date.

Policy and government role: An important distinguishing feature between Thailand and some of the developing countries in which ESCOs/ ESPs have not taken off so well is the clear government support in Thailand. In 1992, Thailand enacted its Energy Conservation Promotion Act (ENCON Act). Under this Act, the Department of Alternative Energy Development and Efficiency (DEDE) manages a required program of efficiency for factories and buildings with peak load of 1 MW or greater. These entities are required to manage energy use in various categories. Energy audits are mandatory, as is setting a plan to reach targets. A revolving fund (EERF, energy efficiency revolving fund, established in 2003) and tax exemptions have been developed under the Act in order to promote the ESCO business and energy efficiency projects more generally. The revolving fund provides low interest loans for energy efficiency projects. Eighty energy efficiency or renewable energy projects financed by loans from this fund were implemented from 2003 to 2005. Total financing of the projects was USD100 million, 54 percent of which came from the fund. The EERF fund is funded by taxes on petroleum consumption. As for the tax exemption, energy efficiency customers (the clients of ESCOs) do not to pay taxes on the portion of increased profit gained from reducing energy consumption. For large corporations, the income tax rate is 30 percent; and for SMEs, 15 percent. Further, there is an eight-year exemption from corporate taxes for ESCOs. [495] Despite the government's initial ENCON ACT measures in 1992 of required conservation for large firms, the ESCO/ESP business did not really get started in Thailand in a substantial way until the World Bank implemented some pilot projects, beginning in 1999.[496]

The corporate tax credits/exemptions for those having energy efficiency projects installed on their premises cannot exceed USD64,000 per year per company. The eight year income tax exemption for ESCOs applies to new companies and is lowered to 70 percent tax exemption for three years in the case of existing companies.[497]

Donors: Donors have played an important role in promoting Thailand's ESCO business. As mentioned, despite the ENCON Act's supportive measures starting in 1992, the industry did not really get started until four pilot ESCO projects were implemented under a World Bank

[494]Strahil Panev et al, JRC, 2014, op. cit.
[495]Chiharu Murakoshi and Hidetoshi Nakagami, 2009, op. cit.
[496]Strahil Panev et al, JRC, 2014, op. cit.
[497]Strahil Panev et al, JRC, 2014, op. cit.

project beginning in 1999. These pilot projects consisted of energy audits at industrial facilities followed by implementation of recommended energy efficiency projects. The audits were covered by donor (GEF) grants, but the energy efficiency installations were paid for by the factories themselves, though sometimes with preferential loans.[498]

Barriers: Some barriers have been covered above in the discussion of issues facing the ESPs/ ESCOs. Financing is discussed below. Yet, financing does not appear to be the major roadblock that it is in some countries. The apparent reason is that in Thailand, the ESP industry has been able to convince the customers to finance the majority of projects, rather than rely on the "ESCOs" for financing. Yet, the difficulty of ESCOs in meeting the banks' collateral criteria is a barrier to shared savings contracts. Another important problem is the lack of accepted standards and protocols for energy savings measurement and verification. Finally, private sector clients may have a problem in identifying qualified ESCOs. A voluntary accreditation program for ESCOs/ ESPs is something that Thailand now lacks, but that might help with this problem.[499]

Financing of Thai ESCO Projects: As mentioned above, the ability of Thai ESCO/ ESP project clients to finance projects has meant that the industry has been able to take off despite the typical problems ESCOs themselves have faced in trying to obtain financing. In order for the industry to benefit from the potential growth in market that would come from having both shared savings and guaranteed savings business models, however, a solution to the issue of low ESCO collateral for loans would have to be found. Some sources suggest a guarantee fund solution be explored. The guarantee fund would be used to help guarantee loans to ESCOs for shared savings projects. There are now two government funds that can provide funding to ESCO projects. These are the aforementioned EERF (Energy Efficiency Revolving Fund), established in 2003, and the ESCO Fund, established in 2008. As discussed in further detail below, analysts indicate these funds have not provided the kind of broad support to the ESCO industry that had been hoped.

The Energy Conservation Foundation of Thailand and the Energy for the Environment Foundation manage the ESCO fund, which was set up in 2008. The ESCO fund appears to have a broader scope than EERF in how it may be used. It can be used to provide factory owners with equipment investment, credit guarantees, and venture capital, as well as to facilitate equipment leasing and to generally support project development via technical assistance for energy efficiency and renewable energy projects. Yet, in its early phase (and as of April 2010), this fund supported mainly renewable energy projects and had almost no energy efficiency projects.[500]

EERF is focused on providing one financial product – loans for energy efficiency projects. It achieves this by providing eleven Thai banks with credit lines at zero interest. The lines are to be used for loans for energy efficiency and renewable energy projects at a maximum of four percent interest. The maximum loan per project is USD1.25 million; and typically the loan should not exceed 50 percent of total project investment. The maximum term is seven years.

[498]Strahil Panev et al, JRC, 2014, op. cit.
[499]Strahil Panev et al, JRC, 2014, op. cit.
[500]Strahil Panev et al, JRC, 2014, op. cit.

Sources indicate the success of EERF has also been limited as it has been used to finance only a very small number of energy efficiency projects. Sources suggest the use of this fund has been low, because banks must assume all the credit risk in loaning to the ESCOs. Because ESCOs tend to have collateral levels insufficient to guarantee their loans, the banks are hesitant to make such loans.[501]

[501]Strahil Panev et al, JRC, 2014, op. cit.

5.3 South Korea

With strong and ongoing government support, the South Korean ESCO market has sustained a significant level of investment for over two decades now. Of particular interest in terms of the purpose of this study, the majority of that investment has been made in the industrial sector.

Overall South Korean ESCO Market: South Korea is largely an industrial economy and has a very high dependence on imports for its fossil fuel use. As such, the government is keen to limit energy use and promote energy efficiency. Korea has had ESCOs since 1992, when the industry was launched with it first three ESCOs. The Korean ESCO industry is supported to a high degree by a program of low interest government loans. In fact, during research for this study, it was found that the numbers many sources were reporting for the size of Korea's ESCO market were either the amounts of low interest loans dispersed annually to ESCOs via these government loans or at levels just somewhat higher than those total loan amounts. In fact, no data on the market surpassing these loans by a large amount was identified. Thus, a question remains of whether the market remains driven fully by availability of these government loans or has taken off to achieve expanded market share without them.

Langlois et al (2013) indicate that there has been steady growth in the South Korean ESCO market since the mid-1990s. They explain that the market is driven by continued demand from multinational companies for ESCO services and that US public facilities in South Korea have also requested that energy efficiency projects in their facilities be undertaken by EPC. They indicate the government, with its adoption of a focus on "green growth," is the primary driver, but that the private sector has come on board.[502]

Yet, data showing steady market growth was not found in the research for this study. Instead, the main data presented by multiple sources was either totals for the low interest government "ESCO Fund" loans or at levels near the total amount of those loans. In the latter case, one might speculate that the numbers then reflect the loan projects only, which also have a minority component of non-loan funding. The government ESCO loans have shown fluctuation since hitting a high of USD153 million in 2005. Between 2006 and 2009, the annual loan amount ranged from USD93 million to USD113 million. Hansen et al (2009) indicate a South Korea ESCO market size of USD75 million in 2001, USD183 million in 2005, and of 136 million in 2007.[503] These numbers compare to government loan levels to ESCOs those years of USD63 million, USD, 153 million, and USD 113 million, respectively. The government loan level was also USD113 million in 2009. [504] One source indicates the full ESCO market was USD167 million in 2010.[505] Another indicated the government loan level would continue to be USD113 million in 2010, but would eventually rise to USD167 million in 2013.[506] The stagnation of government loan amounts does not necessarily imply

[502] Pierre Langlois and Shirley Hansen, *World ESCO Outlook*, 2013.
[503]Shirley Hansen, Pierre Langlois, and Paolo Bertoldi, *ESCOs Around the World: Lessons Learned in 49 Countries*, 2009.
[504] Su-Young Huh, *ESCO System in Korea*, presentation at Asian ESCO Conference in Delhi, January, 2010.
[505]Dong-Wook Kim, *Using the Waste Heat from Refuse Incineration Plant*, presentation at Asian ESCO Conference in Delhi, January, 2010.
[506]Su-Young Huh, 2010, op. cit.

that the ESCO market in South Korea is not growing. Yet, the lack of data in the literature on the broader market is curious and makes it difficult to confirm the purported trend.

Data available on the number of projects in South Korea's ESCO market is also associated exclusively with those projects receiving low-interest loans from the government's ESCO Fund. While total loan amounts have gone up substantially from 2001's level of USD63 million to USD113 million in 2009, the number of projects has dropped during the same period from their maximum of 548 projects in 2001 to 105 projects in 2009. This reflects a shift from focus on lighting systems in buildings in the early 2000s, to more diversified (and more costly) projects encompassing improvement of industrial processes and co-generation.[507]

Main sectors served: Industry is the main sector in which ESCO projects in South Korea are carried out. Commercial buildings are a "distant second." According to Langlois et al (2013), projects appear to be well spread out across a range of industrial subsectors.[508]

Business model: While both guaranteed savings and shared savings contracts exist in South Korea, some sources suggest that the vast majority of ESCO contracts, up to 98 percent, are shared savings. This figure, however, may reflect the situation that all reported projects appear to be ones that receive preferential government loans. Those loans were set up with the intention of being used for shared savings contracts. Others suggest that guaranteed savings contracts have been gaining share, as some customers prefer them. So, perhaps such projects are occurring outside of available data sets. New customer preference for guaranteed savings is said to occur for two reasons: (1) Clients have carried out projects with ESCOs in the past with success and are thus less concerned about the risk of future projects being unsuccessful. (2) Clients have carried out shared savings projects in the past, but have had disagreements with the ESCO regarding the results of monitoring and verification. Large multinationals, in particular, are among those said to prefer guaranteed savings contracts. More recently, power purchase agreement (PPA) contracts have begun to emerge in the South Korean ESCO market, though these are still few in number.[509]

South Korean Industrial Sector ESCO Market: Exhibit 5-2 shows the distribution of project types by investment and number of projects, based on loans disbursed from the South Korean Government ESCO Fund during the period 1993 to 2008. From the data, it can be seen that process improvement, cogeneration, and waste heat recovery are the top three ESCO project types in terms of loan amounts disbursed. While this data is not exclusive to the industrial sector, given the dominance of that sector in the overall market, the data gives a good view of main industrial ESCO project areas in South Korea. In terms of more specific project types, examples of process improvement projects include: (1) naphtha cracking heater coil replacement and (2) ejector type replacement (replacing steam by EG type). Examples of waste heat recovery systems include: (1) waste heat recovery boiler, (2) mechanical (thermal) vapor re-compressor, and (3) heat exchanger for heating and cooling.[510]

[507]Su-Young Huh, 2010, op. cit.
[508]Pierre Langlois and Shirley Hansen, 2013, op. cit.
[509]Pierre Langlois and Shirley Hansen, 2013, op. cit.
[510]Su-Young Huh, 2010, op. cit.

Exhibit 5-2: Project Types Supported by Government of South Korea's ESCO Fund from 1993 to 2008

Type of Project	Project Loan Amount from Government ESCO Fund	Number of Projects Funded by Government ESCO Fund
Process improvement	322 million USD	300 projects
Cogeneration	277 million USD	112 projects
Heat recovery	183 million USD	301 projects
Heating and cooling	120 million USD	187 projects
Lighting	113 million USD	1,810 projects
Motors	89 million USD	254 projects
Power	36 million USD	94 projects
Other	28 million USD	73 projects

Source: Su-Young Huh, *ESCO System in Korea*, presentation at Asian ESCO Conference in Delhi, January, 2010.

South Korea's ESCOs: South Korea has a great number of registered ESCOs, but the number of active ESCOs may be a minority of the total. The EU's JRC reported that there were 227 registered ESCOs in South Korea in 2012, an extremely large rise from 2009, when there were 126.[511] Su-Young Huh (2010) has indicated that, of the 126 registered ESCOs in 2009, only about 30 to 40 were active. Huh further notes that about 30 ESCOs typically register each year and 30 ESCOs lose (or cancel) registration each year.[512] Langlois et al (2013) have noted that, in the mature South Korean ESCO market, competition is intense; and a number of ESCOs fail each year.[513]

In terms of type of companies that are ESCOs, Langlois et al (2013) suggest the market has a mix of the largest multi-national ESCOs and smaller, local counterparts.[514] Writing in 2005, J. H. Shin et al have suggested that most of the ESCOs in South Korea are small and medium sized businesses and thus have problems obtaining financing for shared savings projects.[515]

KAESCO, the Korean Association of ESCOs, serves as facilitator of the industry at both the national and local levels. The association has organized many events that serve to share information and build awareness of the industry. They have also worked with universities to put on training courses for ESCO personnel. [516]

Drivers of South Korean ESCO Market: National government policy and programs, particularly the ESCO low interest loan program, are key drivers of the South Korean ESCO industry. The Government's actions, in turn, are driven by South Korea's heavy dependence on fossil fuel imports. Industry also responds to energy costs by increasing its interest in energy efficiency opportunities. Now that the ESCO industry has been around in South Korea for over two decades, there is a strong abundance of experts, both from academia and private

[511]Strahil Panev et al, *ESCO Market Report for Non-European Countries 2013*, EU Joint Research Center's Institute for Energy and Transport, 2014.
[512]Su-Young Huh, 2010, op. cit.
[513]Pierre Langlois and Shirley Hansen, 2013, op. cit.
[514]Pierre Langlois and Shirley Hansen, 2013, op. cit.
[515]J.S. Shin, I.H. Ahn and Suduk Kim, *ESCO Business in Korean Energy Market: The Current Issues and Possible Solutions*, presentation in April, 2005.
[516]Strahil Panev et al, 2014, op. cit.

companies, who can advise various parties on the industry. This resource, in turn, reinforces the strength of the industry.[517]

The South Korean Government has promoted the ESCO sector in multiple ways, some direct and some indirect. On the indirect level, they promote energy efficiency in potential industrial ESCO clients through a five-year voluntary agreement program. Businesses that join the program can receive financial and technical support and tax credits covering up to 20 percent of the investment cost of energy efficiency projects. Further, since 2007, large energy consuming entities (over 2 ktoe/year) have been required to carry out mandatory energy audits every five years. Industries that invest in CHP for their own heat supply can receive tax reductions. Further, factories consuming over 20 ktoe (or over 10 ktoe for those in the automobile, food, and electrical and electronics industries) can participate in the Government's Energy Savings Partnership Program, whose focus is sharing energy saving technologies specific to certain industries. In 2013, ABB reported that 195 companies were involved in this program, which led to substantial savings in both fuel and electricity.[518]

On the direct level, the South Korean Government has developed a legal framework to support ESCOs, institutions that finance ESCO projects, and the clients of ESCOs. It also has preferential financing and tax programs to promote ESCOs.[519] Following the establishment of the first four ESCOs in 1992, the Government set up its ESCO Fund, which is meant to support the shared savings projects of small and medium sized ESCOs. In 2004, it introduced the guaranteed savings contract model to the country. And, in 2006, an ESCO accreditation program was developed.[520]

Financing of Korean ESCO Projects: South Korea's energy conservation fund was established in 2008 and is managed and operated by the Korea Energy Management Corporation ("KEMCO"). The fund is known as the "Rational Use of Energy Fund." References to the "ESCO Fund" are actually references to the component of this fund used to support loans to ESCO shared savings projects. Exhibit 5-3 shows the total amount of loans from the Rational Use of Energy Fund and that part of the total going to ESCO projects. Due to the recession and drop in global oil prices (taxes on petroleum are the source of funding), total fund amounts dipped in 2009 and 2010. Of the USD427 million total loan amount in 2010, aside from the USD113 million going to ESCOs, other categories receiving loans were: (1) installation of energy saving facilities (USD172 million), (2) voluntary agreements (USD117 million), and (3) integrated energy supply (25 million). Presumably, some of these other areas might stimulate ESCO or ESP activities, though the loans will go directly to the client entities instead of the ESCOs. The repayment period for loans is four to ten years.[521] Aside from this Government loan fund, small and medium sized ESCOs may have trouble receiving commercial bank loans for shared savings type projects due to their limited amount of collateral.[522] Indeed, aside from the Government fund, there was not much evidence in the

[517]Pierre Langlois and Shirley Hansen, 2013, op. cit.
[518]ABB, South Korea Energy Efficiency Report, 2013.
[519]Pierre Langlois and Shirley Hansen, 2013, op. cit.
[520] Su-Young Huh, 2010, op. cit.
[521]Su-Young Huh, 2010, op. cit.
[522]J.S. Shin, 2005, op. cit.

literature for other types of programs to stimulate commercial bank lending to ESCO projects.

Exhibit 6-3: Government of South Korea Rational Use of Energy Fund: Total Annual Loan Amounts and Subtotal Going to ESCO Shared Savings Projects (in USD)

Item	2006	2007	2008	2009	2010	2013 (e)
Loans to ESCOs	$111 M	$113M	$93M	$113M	$113M	$167M
Total loans	$537M	$514M	$566M	$486M	$427M	NA

Source: Su-Young Huh, *ESCO System in Korea*, presentation at Asian ESCO Conference in Delhi, January, 2010.

6. Europe

6.1 Germany

Overall German ESP and ESCO Market: Germany is considered one of the leading European ESCO markets, in terms of both market scale and maturity. The EU's JRC found that Germany's ESCO market had continued to grow during the period 2010 to 2013 and that the majority of stakeholders they interviewed expected continued growth in ensuing years.[523] While Germany appears to have a much smaller EPC market that the US, the majority of its ESCO market consists of its energy supply contract (ESC) market, which is very large. While many ESC projects increase energy efficiency, some do not, thus blurring the lines in terms of this report's efforts to focus on energy efficiency markets.

Some data is also available on the scale of non-ESCO segments of Germany's ESP markets, such as pure provision of energy consulting or energy management services. As in the US, such services may play the more significant role of ESPs in Germany's industrial sector, as EPC contracting in that sector appears to be quite limited. Yet, "apples to apples" comparisons between Germany's ESCO and non-ESCO ESP market sizes is difficult, as available data on the latter does not include equipment and fuels, and does not always include installation costs, while data on the ESCO market does.

Exhibit 6-1 presents data and a conceptual means of comparing the various segments of Germany's ESP market for the year 2011.[524] In that year, the German ESCO market was estimated at €3 billion. The EU JRC's 2013 estimate for the German ESCO market is €3.5 to 5 billion. The EU JRC further suggests a breakdown of the German ESCO market by volume as 80 to 85 percent energy supply contracts (ESCs) and eight to nine percent energy performance contracts (EPCs). Contract breakdown will be discussed further below, but these proportions offer the important insight that ESCs drive the very large scale of Germany's ESCO market. EU JRC further estimates a total *potential* German ESCO market of €20 to 30 billion annually, the large scale of which is likely to be due to untapped potential to expand ESCs, which include fuel costs.[525] Ruth Offermann et al (2013) propose a breakdown of the German ESP market into: (1) ESCO business, (2) pure energy advice and audit services, and (3) energy management services. They estimate the 2011 German energy advising and audits business to be €265 to 467 million in scale and the energy management systems market that year to be €250 to 500 million in scale.[526]

[523]Paolo Bertoldi et al, *European ESCO Market Report 2013*, EU Joint Research Center's Institute for Energy and Transport, 2014.
[524]Jan W. Bleyl and Friedrich Seefeldt, "Germany," draft chapter for *World ESCO Outlook*, 2012.
[525]Paolo Bertoldi et al, 2014, op. cit.
[526]Ruth Offermann et al, *Monitoring the Energy Efficiency Services Market in Germany*, ECEEE Summer Study Proceedings, 2013.

Exhibit 6-1: Rough Breakdown of Germany's ESP and Energy Efficiency Market (2011)

ESCO Market ("Energy Contracting Services")			**Non-ESCO ESP and Related Equipment/ Fuel Market**		
			Non-ESCO ESP Market		**Equipment/Fuel**
€3 billion			**Energy Advising and Audit Services**	**Energy Management Services**	**Equipment (and installation if not included elsewhere)/ Fuel**
EPC Market	**Energy Supply Contract (ESC) market**	**Other types of ESCO contract market**			
€270 million	€2.5 billion	€240 million	€265 – 467 million	€250 – 500 million	Unknown but needed for "apples to apples" comparison
9% of ESCO market	83% of ESCO market	8% of ESCO market			

Sources: Jan W. Bleyl and Friedrich Seefeldt, *World ESCO Outlook: Germany*, 2012 (ESCO market size); Ruth Offermann et al, *Monitoring the Energy Efficiency Services Market in Germany*, 2013 (market sizes for energy advising and audit services and for energy management services); Paolo Bertoldi et al, European *ESCO Market Report 2013*, EU Joint Research Center's Institute for Energy and Transport, 2014 (percentage breakdowns of ESCO market by contract type).

Business models and contract types and size: As mentioned, about 80 to 85 percent of ESCO projects in Germany by volume are energy supply contracts (ESCs), while only eight to ten percent are EPCs. For both types of contracts, the predominant models are those in which the ESCOs handling financing, such as the shared savings contract in the case of EPC. The average size of energy supply contracts (€20,000 per year) is much smaller than the average energy baseline addressed by EPC contracts. Energy savings for energy supply contracts is based mainly on fuel switching and renewables; and typical annual energy savings is 15 to 20 percent. EPC projects in Germany generally address an annual energy cost baseline of over €150,000. Energy savings may reach 20 to 25 percent or even 30 to 50 percent.[527] Maike Bunse and Wolfgang Irrek (2010), referencing sources from the late 2000s, indicate the estimated number of ESCO contracts (both ESC and EPC) in Germany at any one time is about 50,000. They note a source that projects the *potential* number of such contracts to be about 1.3 million.[528]

Client segment addressed: The majority of the German ESCO market is focused on buildings rather than industry. Building types include institutional, residential, and commercial. Jan W. Bleyl and Friedrich Seefeldt (2012) estimate that the German ESCO market is 60 percent residential, 15 percent institutional, and up to 20 percent industrial and commercial combined. Yet, along with other sources, they suggest the industrial and commercial markets are growing. They indicate that German energy supply contracts (ESCs) mainly serve the residential sector, though industry and public facilities are also significant market segments.[529] As for EPCs in Germany, these are mainly focused on the public sector, where they are used for upgrading of administrative buildings, hospitals, swimming pools, housing, and educational facilities. While less common, EPCs also exist in the service sector,

[527]Paolo Bertoldi et al, 2014, op. cit.
[528]Maike Bunse and Wolfgang Irrek, *National Report on the Energy Efficiency Services Business in Germany*, Wuppertal Institute, 2010.
[529]Jan W. Bleyl and Friedrich Seefeldt, 2012, op. cit.

such as hotels.[530] As this study is especially concerned with ESPs in the industrial sector, an important conclusion based on the foregoing information is that in Germany there is a small proportion of energy supply contracting (ESC) in the industrial sector and little if any EPC activity in that sector. Thus, one may conclude that, as in the US, the predominant involvement of ESPs in the industrial sector is likely manifested in non-ESCO scenarios, such as service provided by engineering firms or equipment vendors and installers. Further, as with US industry, German industry is likely to have some degree of internal capabilities in energy efficiency projects as well.

Types of ESCO projects in Germany as presented by the EU JRC analysis fit with this view that industry is only a small portion of the German ESCO market. Related to ESCs being the main type of contract, the most common German ESCO projects, according to the JRC, are in heating and hot water supply, renewables, and CHP. In addition, public lighting, control and automation, and pumps are frequently upgraded. Projects in the areas of industrial processes, industrial cooling, motors, inverters, indoor lighting, and air conditioning and ventilation are less common, as are insulation in building shell and whole building refurbishment.[531] Jan Bleyl and Friedrich Seefeldt (2012) identify the technologies for Germany's ESCs as ranging from standard boilers to CHP. Yet, they find that most measures are limited to boiler rooms. They indicate the majority of projects run on natural gas, though a variety of renewable energy heating systems and solar systems have been installed to date.[532] Yet, despite German ESCOs' lack of focus on any technologies that are exclusively industrial, sources appear to agree that industrial sector clients, while a minority, are becoming somewhat more popular with German ESCOs.

German Industrial Sector ESCO and ESP Market: Sources indicate special challenges to growing the German industrial sector ESCO market, but also strong potential for ESCOs or non-ESCO ESPs to contribute to German industrial energy efficiency. Maike Bunse and Wolfgang Irrek (2010) suggest that ESCOs and ESPs targeting Germany's industrial sector need to be skilled in more highly specialized areas than those targeting the building sector only. The industrial sector, they explain, is a "niche market" within energy supply and energy performance for ESCOs. Thus ESPs need to go beyond the supply of energy and heat (as in ESCs) to address the supply of things like cold for industrial processes or compressed air. They will need specialized knowledge and sometimes specialized equipment to address such areas. ESCOs serving the industrial sector in Germany may also face difficulties specific to the industrial sector. As a result of the type of difficulties, there may be more opportunity for energy supply contracts (ESCs) than for EPC contracts. Specific difficulties include the frequent unwillingness of industrial clients to engage in projects with payback times longer than three to five years. They are risk averse when it comes to areas outside their core business. (ESCOs in turn, may face the risk of client insolvency on the timescale of ESCO contracts when they deal with the industrial sector.) Further, potential industrial clients often prefer to develop in-house capabilities so as not to become dependent on contractors, in this case the ESCO. Another problem is that EPC tends to be very complex in the industrial sector, as monitoring and verification are more difficult and baselines may change from year

[530]Paolo Bertoldi et al, 2014, op. cit.
[531]Paolo Bertoldi et al, 2014, op. cit.
[532]Jan W. Bleyl and Friedrich Seefeldt, 2012, op. cit.

to year. Thus, one recommendation made for the German ESCO industry in approaching industrial clients is to engage in energy supply contracting with them and include additional technical services, rather than bundle such services in an EPC. As a result of these challenges, there are not many companies providing EPC to Germany's industrial sector. In fact, it is estimated that only ten to 15 companies in Germany are active in EPC for the industrial sector. Further, none of them is solely focused on that sector.[533]

At the same time, strong market potential (of one hundred million Euros or more) has been suggested in Germany for EPC in each of a number of industrial sectors. These sectors include: the automotive and machinery industry, the plastics and rubber industry, and the chemical and pharmaceutical industry. Annual market potential of over 50 million Euros has been indicated for each of: the food and beverage industry; the glass, ceramic, and non-metallic mineral processing industry; and the metal and steel industry.[534] A challenge to ESCOs and ESPs wishing to serve these industries is that a specialized approach by sector will be needed in addition to skills in cross-cutting areas like compressed air, lighting, pumps, and motors. [535]

Bunse and Irrek (2010) also see opportunities for ESPs to address unmet needs of industrial SMEs. They imply that the main ESCO services provided to SME industrial facilities at present are heating services. They suggest there is a market need to provide services to industrial SMEs in cross-cutting technologies, such as the provision of light, compressed air, and ventilation, and production of cold.[536]

German ESCOs and non-ESCO ESPs: A large number of companies and a range of types of companies participate in Germany's ESCO and non-ESCO ESP markets. In terms of ESCOs, it has been estimated that 500 to 550 companies classified as ESCOs were in the German market in 2013. As for companies providing energy advice and audit services, an estimate of 12,500 to 14,000 providers has been made for 2011. As for providers of energy management services, a complete estimate was not found in the literature, though data indicates that there were 776 companies certified in ISO50001 in Germany in 2011 and about 70 companies with energy management software products that year. Exhibit 6-2 below summarizes some of the numbers and characteristics associated with each main type of ESP as indicated by Offermann et al (2013).[537]

Offermann et al (2013) describe a range of types of ESPs involved in providing energy efficiency services in Germany. These include "pure" ESCOs, energy companies, engineering companies, consultants, and energy efficiency equipment providers. In terms of the last group, it is the providers of building equipment and measurement and control systems that are most active in the ESCO market. Others involved include craftsmen, planners, and architects. Offermann et al (2013) emphasize that not all of these types of companies provide

[533]Maike Bunse and Wolfgang Irrek, 2010, op. cit.
[534]Maike Bunse and Wolfgang Irrek, 2010, op, cit.
[535]Maike Bunse and Wolfgang Irrek, 2010, op, cit.
[536]Maike Bunse and Wolfgang Irrek, 2010, op, cit.
[537]Ruth Offermann et al, 2013, op. cit.

the full range of energy efficiency services. Some provide only a part of these, such as audits or installation of energy management systems.[538]

Exhibit 6-2: Numbers of and Characteristics of Different Types of German ESPs (2011)

Energy Advice and Audit Services Companies	Energy Management Services Companies	Energy Services Contracting (ESCOs)
-companies: 12,500 to 14,000 -contracts/yr: 370,000 to 410,000 -employees: 47,000 to 52,000 -turnover: €265 – 467M	-overlap with other areas (31% of energy contractors and 21% of advice and audit consultants also provide EM services) -suppliers of energy management software: 70 -companies certified in ISO50001: 776 -turnover: €250 – 500 M	-companies: 500 to 550 -typical turnover per supplier: €3-8 M (spread of €100,000 to €90 M) -contracting services often just a small part (less than 5%) of business -total ESCO turnover: €3 B

Source: Ruth Offermann et al, *Monitoring the Energy Efficiency Services Market in Germany*, 2013.

The EU JRC includes energy companies, ESCO companies, engineering companies, and other suppliers among those that provide ESCO services in Germany. They further break down ESCO company types into those that provide ESC and those that conduct EPC. They note that the composition of ESCOs in Germany in this regard has not changed much in the last five to ten years. The companies involved in energy supply contracting (ESC), they indicate, are mainly building equipment and control manufacturers, engineering firms, facility management and operation companies, and energy companies. Most are international firms, though more local firms have entered the market recently due to increased interest by customers. Smaller ESCOs face challenges due to the legal environment and competition. As for EPC providers in Germany, these, the EU JRC indicates, are also mainly large international companies or their subsidiaries. The EPC providers also include project developers, financial organizations, and craftsmen. There are no public ESCOs in Germany.[539] Sources seem to agree that small companies do not play a large role in the German ESCO market, though they may in other areas such as energy advice and audit provision. Indeed, one source indicates that a survey of energy consultants found their average income from energy consulting was only 10,000 to 20,000 Euros per year. This same source indicates that, in terms of ESCO business, the main focus of smaller companies is heat delivery services (heat supply contracting) in the residential, commercial, and public sector.[540]

Of the 500 to 550 ESCOs in Germany, many do not have energy supply contracting or EPC as their main area of business. The EU JRC estimates that less than 30 percent of these companies have one of those two forms of contracting accounting for 30 percent or more of their turnover. They further note that ESC and EPC are less than five percent of the revenues

[538]Ruth Offermann et al, 2013, op, cit.
[539]Paolo Bertoldi et al, 2014, op. cit.
[540]Maike Bunse and Wolfgang Irrek, 2010, op. cit.

of 60 percent of Germany's ESCOs. In all, they find that only about ten companies are focused narrowly on EPC in Germany.[541]

The EU JRC finds that market facilitators (agencies and associations) play a critical role in the German market in providing communications, networking, and advice in support of ESCOs and ESCO projects. Energy agencies may help municipalities in procuring ESCO services. In Germany, there are also several associations related to ESCOs and ESPs, including: (1) the Association for Heat Supply (VfW), (2) the National Association for Electrical and Electronics Industry's (ZVEI's) ESCO Forum, (3) the Association of German Energy Service Providers (BDE), (4) the Association of Energy Contractors (Forum Contracting e.V.), (5) the Building Automation subgroup of the National Association for Machinery and Industrial Equipment Manufacturers (VDMA), (6) the Association for District Heating and Contracting (AGFW), and (7) the German Industrial Initiative for Energy Efficiency (DENEFF).[542] Bunse and Irrek (2010) indicate that the two most active associations in terms of ESCO business are (a) the ESCO Forum of the National Association for Electrical and Electronics Industry and (b) the Association for Heat Supply (VfW). The ESCO Forum had 24 members in 2009 and represents larger ESCOs. Among members are subsidiaries of Germany's multinational energy companies, large heating and building control equipment retailers, and also some large public service companies. The Association for Heat Supply (VfW) had 255 members in 2009. Eighty of these conduct energy supply contracting projects, which can but do not necessarily include energy efficiency measures. Members are mostly installers and suppliers of heating systems, public service companies, and building control equipment suppliers.[543]

Drivers of and Barriers to the German ESP and ESCO Market: Germany's ESCO and ESP market are mainly demand driven as a result of both energy costs and government policies, such as ambitious carbon targets. Stakeholders in the ESCO industry have also suggested that the development of smart technologies for buildings is a key driver to expansion of their market. Clients' lack of capital and the role of facilitators (such as energy agencies) also help to drive the market.[544]

A number of barriers to progress in the German ESCO market have also been identified. First, while the legislative framework may be more advanced that in many other European countries, there are complaints that it is unclear and inconsistent. Second, competition in the ESCO market is high, especially because utility ESCOs may not focus on the profitability of their ESCO projects, due to a focus on other objectives (such as meeting obligations or expanding services to increase customer satisfaction). Further, while in other countries obtaining loans for ESCO projects is difficult, German banks are quite familiar with ESCO projects. As a result, the bigger problem is that ESCOs may reach their credit limits. Finally, newcomers to the sector face challenges due to ongoing suspicion of ESCO offers. Companies with proven success in the German ESCO market clearly have the edge over these newcomers.[545]

[541]Paolo Bertoldi et al, 2014, op. cit.
[542]Paolo Bertoldi et al, 2014, op. cit.
[543]Maike Bunse and Wolfgang Irrek, 2010, op. cit.
[544]Paolo Bertoldi et al, 2014, op. cit.
[545]Paolo Bertoldi et al, 2014, op. cit.

German Government Policy and Programs Relevant to ESPs and ESCOs:

SME audit program: Of all of Germany's national programs for energy efficiency, the one that may have received the most prominence in the literature for positive results is a program providing subsidies for energy audits in SMEs. The program, which began in 2008, encompasses both manufacturing and non-manufacturing SMEs. The program subsidizes initial (screening) audits, which last two days, with an up to 80 percent subsidy. It subsidizes comprehensive audits, which last up to ten days, with an up to 60 percent subsidy. The program is managed by KfW. Names of consultants that provide audits and have registered with KfW are provided online. In practice, however, it is often the consultants that reach out to the SMEs to promote the opportunity. Between 2008 and 2010, there were 10,400 applications approved for such audits. This is quite a large number of audits for three years compared to the US SME industrial facility audit program, which achieved about 18,000 audits over 40 years. It should be noted, however, that the US audits were all industrial, while many of the German SMEs receiving audits were not industrial. The average scale of the German companies receiving audits was eleven to 50 employees. A sector analysis of energy audit recipients in the German program shows that the percentage of hotels and restaurants, food industry, metalworking, and "office-like" enterprises is higher than the percentage of these sectors in the overall SME economy.[546]

The German audit program, like the American one, does not have much to do with ESCOs. It is discussed here as part of the exploration of the role of German ESPs (including energy audit companies) more generally. The program has a good reputation, because of a high rate of implementation of audit recommendations and the substantial associated energy savings. According to a follow up review of the audits from 2008 to 2010, an average of 2.8 out of an average of 5.3 recommended measures per SME were implemented. The measures implemented resulted in 480 million Euros of investment and energy cost savings of 80 million Euros annually. Reasons for success include: (1) easy access to audits resulting from high funding level, (2) support of regional partners and their personal contacts with local SMEs, and (3) the generally high quality of audits. Recommendations made for improvement in the program are: (A) Improve the online search function for competent audit consultants. In particular, it is suggested that SMEs be able to search for consultants that have know-how in sector-specific process technologies. (B) Improve the quality of the audit reports by including a more detailed specification of content. About 23 percent of the consultants involved in the audits were building specialists, with a similar percentage focusing on either lighting, ventilation or heat recovery. Only eleven percent of the consultants have specialized knowledge in industrial process.[547]

According to the survey of program operation from 2008 to 2010, companies paid an average of €900 on average for the initial audit and received €1,200 subsidy, in addition, for it. For the detailed audits, they paid on average €2,000 and received €4,000 in subsidy. This suggests average total cost per audit of €2,100 for the short audits and €6,000 for the long

[546]Edelgard Gruber et al, *Efficiency of an Energy Audit Program for SMEs in Germany – Results of an Evaluation Study*, ECEEE Summer Study, 2011.
[547]Edelgard Gruber et al, 2011, op. cit.

ones, both less than the average of USD10,000 subsidy per audit for the US IAC program.[548] At the same time, it should be noted that the facilities audited by the US program are probably, on average, significantly larger and more complex than the average German SME audited. Further, the US program involves university studies and has workforce training objectives, while the German program does not. According to Barbara Schlomann and Wolfgang Eichhammer et al (2012), in addition to audit subsidies, government financial support may also be available to German SMEs for implementation of audit recommendations. This may be the case when at least 20 percent annual energy savings compared to the baseline of the preceding three years can be achieved.[549]

Policy: According to the EU JRC, national and European legislation are considered key drivers of the German ESCO market. German legislation is extremely supportive of energy efficiency and renewables. Energiewende, the energy transition strategy of the country, gives great emphasis to energy efficiency.[550] Yet, ESCOs claim some biases against them. For example, Germany's Renewable Energy Act disadvantages energy services contracting (ESC) in comparison to owner operated heating installations, such as small scale CHP. In the ESCO case, the ESCO has to pay for the renewable energy assessment, whereas in the owner-operated case, the owner does not have to pay.[551] Of further concern to ESCOs are potential changes being discussed for Germany's Energy Tax Law. These changes could result in unequal tax treatment for energy investments made by the ESCOs as compared to such investments made directly by their customers. This is considered something that could potentially destroy Germany's ESCO industry.[552]

Financing of German ESCO Projects: While there are some financial incentives in areas such as building refurbishment and energy audits, many German ESCO projects and other energy efficiency initiatives are carried out without such incentives. The shared savings model tends to be preferred in Germany, so that the client does not have to provide the upfront costs. Thus, financing is most often handled by the ESCO. Municipalities, as an example, may be capable of implementing renovations on their own, but turn to ESCOs mostly to ensure financing. Banks in Germany are quite active in ESCO project financing and do not seem to have the lack of understanding of ESCOs encountered at banks in other countries studied in this review.[553]

[548]Edelgard Gruber et al, 2011, op, cit.
[549]Barbara Schlomann and Wolfgang Eichhammer et al, *Energy Efficiency Policies and Measures in Germany*, Fraunhofer Institute, November, 2012.
[550]Personal communication with Rod Janssen, Dec. 2015, op. cit.
[551]Paolo Bertoldi et al, 2014, op. cit.
[552]Maike Bunse and Wolfgang Irrek, 2010, op. cit.
[553]Paolo Bertoldi et al, 2014, op. cit.

6.2 Italy

The Italian ESCO market is considered to be one of the more developed ones in Europe, because of the large group of companies involved and relatively large volume of business. The definition of ESCO, however, has led to some confusion and disagreement in the Italian market about which companies are really ESCOs. It is also thought to have led to an overestimation of Italy' ESCO market size.[554] Within the market of ESCOs and non-ESCO ESPs in Italy, there is an interesting breakdown of large companies for which energy efficiency is only a minor part of their business and small companies for which energy efficiency is the core of their business. The large companies tend to be associated with the largest ESCO projects, particularly in the public sector, while the smaller companies address smaller ESCO and non-ESCO ESP assignments, mainly in the private sector.[555]

Overall Italian ESP and ESCO Market: The EU JRC (2014) estimates an Italian ESCO market size of €500 million for 2011. This scale includes all types of ESCO contracts and, for the energy supply contracts (ESCs), includes fuel costs. They further find that the rate of growth of the Italian ESCO market in 2010 to 2013 was not as great as before. They indicate a range of €1 to 10 billion per year in terms of estimates various experts have offered for the full ESCO market potential in Italy.[556] Sabbatucci and Labanca (2009), for the year 2009, estimate a market size of €1.83 billion for all ESCOs and non-ESCO ESPs in Italy and €532 million for the subset of ESCOs and non-ESCO ESPs for which energy efficiency is the core business.[557]

ESCO contract types and number**:** The estimated number of active ESCO contracts in Italy in 2013 was in the hundreds. The largest proportion of the Italian ESCO market is served by energy supply contracts (ESCs), whereas EPCs are less common. Traditionally, Italian ESCs have been *chauffage* contracts, also known as "heat supply contracts," or *servizio calore* in Italian. In such contracts, the ESCO is paid a pre-agreed amount for energy supply. Energy efficiency is not necessarily required. More recently, this contract type is being replaced by "energy service plus contracts," or *servizio energia plus* in Italian. The new contract type has the added requirement that the ESCO reduce energy consumed for winter heating by a minimum of ten percent. In addition, a temperature control system should be installed when possible. ESCOs tend to provide a package of services in their ESCs, combining traditional energy supply with energy management and energy efficiency improvements.[558]

Perhaps partly because of the inclusion of energy efficiency in broader ESC contracts, the adoption of EPCs in Italy has been limited. EPCs that do exist are used for smaller projects in areas such as cogeneration, heating management, and efficient lighting. In the EPC category, both guaranteed savings and shared savings contracts are used.[559]

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[554]Paolo Bertoldi et al, *European ESCO Market Report 2013*, EU Joint Research Center's Institute for Energy and Transport, 2014.
[555]Nathalie Sabbatucci and Nicola Labanca, *National Report on the Energy Efficiency Service Business in Italy*, 2009.
[556]Paolo Bertoldi et al, 2014, op. cit.
[557]Nathalie Sabbatucci and Nicola Labanca, 2009, op. cit.
[558]Paolo Bertoldi et al, 2014, op. cit.
[559]Paolo Bertoldi et al, 2014, op. cit.

In Italy, other kinds of ESCO contracts are also found. For example, broader types of contracts, such as facility management contracts, in some cases are combined with some amount of guaranteed savings. Further, BOOT contracts are relatively common.[560]

Sectors served and type of projects: Sources indicate that Italy's ESCOs have put their focus on the largest and most profitable projects, such that energy efficiency opportunities in Italy's vast small and medium enterprise sector and in households remain largely untapped. Partly because of this preference for larger projects, the public sector is the sector in which the most energy efficiency work has been done. Healthcare, in particular, is the most addressed area. Energy efficiency work by ESPs in industry (which consists mostly of SMEs) is growing, though is still limited and constrained by financing. The residential sector remains largely unaddressed.[561]

Sabbatucci and Labanca (2009) find that the SME sector represents the largest area of untapped potential for ESPs in Italy, citing "close to non-existing" competition, with few ESPs choosing to address this market. SMEs will require tailored solutions, they note, whereas the large ESCOs tend to offer services designed for larger projects. The SME energy efficiency market, then, may be most suitable to the group of small ESPs in Italy. At the same time, as Sabbatucci and Labanca (2009) point out, the standardized projects publicized by the Italian Authority for Electricity and Gas (AEEG) and required to obtain white certificates are a disincentive to pursuing the customization needed by SMEs.[562]

The most typical technologies and applications used by Italian ESCOs, based on their responses to a 2011 survey of their activities from 2005 to 2011, are: energy production and CHP (35% of ESCOs), renewables (34%), lighting (30%), climatization (18%), energy management (15%), electric motors and inverters (14%), district heating (14%), insulation measures (9%), and energy efficient refrigeration (8%).[563]

Italian Industrial Sector ESCO Market: As mentioned, there has been some penetration of ESCOs into Italy's industrial market, but the largely SME industrial base still represents perhaps the highest potential untapped market for Italian ESCOs and non-ESCO ESPs. Some industrial areas have been more deeply pursued. For example, cogeneration is widespread in Italy's paper industry. Yet, in areas like the food sector and the textiles sector, there is much room for energy efficiency improvements. One challenge indicated is that Italy's industrial sector, with all of its SMEs, is vertically quite fragmented. That is, the steps along a value chain for production of various products are separated among several companies. Thus, it is hard to implement integrated energy management strategies. Yet, if there were more coordination, more savings of energy and resources might be achieved. For example, waste could be recycled from within the country, rather than having scrap materials purchased from abroad.[564]

[560]Paolo Bertoldi et al, 2014, op. cit.
[561]Nathalie Sabbatucci and Nicola Labanca, 2009, op. cit.
[562]Nathalie Sabbatucci and Nicola Labanca, 2009, op. cit.
[563]Paolo Bertoldi et al, 2014, op. cit.
[564]Paolo Bertoldi et al, 2014, op. cit.

The part of the industrial sector that has been penetrated is served by the small, private ESCOs and non-ESCO ESPs. The main services they provide in the industrial sector are energy audit, project design, plant and equipment installation, and verification of results. The financing of industrial ESCO and non-ESCO ESP projects comes from client self-funding and from bank loans.[565]

Italian ESCOs and ESPs: While lack of clarity on the definition of ESCO has led to confusion on the actual number of ESCOs in the country, the EU JRC (2014), using a definition that includes performance based contracts rather than fee-for-service, estimates Italy had between 100 to 150 true ESCOs in 2009. They further note that the market and number of actual ESCOs did not change much from the 2009 level in the period of 2010 to 2013. The Italian Regulatory Authority for Electricity and Gas has a registry of "Energy Services Enterprises," in which 2,000 to 3,000 companies are registered. The purpose of the registry is that the companies listed have access to the nation's white certificate mechanism, meaning that they are qualified to apply for benefits under the mechanism. Yet, only a small proportion (387 companies) had obtained such a certificate by 2013. Further, while many of these companies describe themselves as "ESCOs," experts indicate that far fewer have actually undertaken ESCO projects. In 2010, Italy created a standard for ESCOs to overcome this confusion. Forty-nine companies were registered under this standard as of 2013.[566] According to ICIM, "the [ESCO] standard regulates the services and defines the certification criteria in relation to organizational, diagnostic, management and economic-financial skills that an ESCO must possess in order to be qualified correctly as such." ESCOs certified via the standard have advantages in public tenders.[567]

Type of companies: As noted, there is a divide in the Italian market between (1) the very large ESCOs serving large public projects and counting the ESCO business as only a small part of their overall business and (2) the small ESCOs and non-ESCO ESPs focused fully on the energy efficiency business and on smaller projects. The EU JRC (2014) finds that, in terms of market volume, the Italian ESCO industry is dominated by a few large ESCOs, which are mainly subsidiaries of large corporations. While 60 percent of ESCOs have staff of less than ten, these very small ESCOs accounted for just ten percent of market volume in 2010. ESCOs with over 250 staff accounted for 50 percent of market volume in 2010, though represented only five percent of Italian ESCOs by number. The large companies have strong engineering and financial capabilities. Further, Italy's legislative framework related to ESCOs is said to favor the larger ESCOs.[568]

Sabbatucci and Labanca (2009) offer more detail on the two general ESP categories (large and small) in the Italian market. According to them, the large companies consist of: multi-utility companies, energy distributors, retail energy sale companies, and consulting firms. The business of these large providers is rarely focused on energy efficiency alone. Due to their

[565]Nathalie Sabbatucci and Nicola Labanca, 2009, op. cit.
[566]Paolo Bertoldi et al, 2014, op. cit.
[567]ICIM company website, accessed in December 2015 at http://www.icim.it/en/uni-cei-11352-gestione-dellenergia-societa-che-forniscono-servizi-energetici-esco/ .
[568]Paolo Bertoldi et al, 2014, op. cit.

financial capabilities and connections, they are able to pursue very large projects in the public sector and win public tenders. Looking at only the segment of the ESCO market served by these large companies for whom energy efficiency is not the core business, Sabbatucci and Labanca find that the top three companies in terms of market share are: (1) Siram (27.1 percent market share in 2008), (2) Elyo Italia (23.1 percent), and (3) Cofathec Servizi (14.1 percent). These three all focus on the public sector, especially health care, with their main area of work being to provide efficient heating services. The fourth largest, (4) Carbotermo (3.5 percent market share), is more active in the industrial and residential sectors. These top four companies controlled about 70 percent of the "large ESCO market" based on 2008 statistics.[569]

The small ESPs, in contrast, have energy efficiency as their core business. Their areas of focus include efficient electricity production, lighting services, and electrical drive efficiency, which tend to be associated with private sector opportunities, particularly those in industry and the commercial sector. For these smaller companies, customization of their product to their clients is important in marketing. Further, the initial audit is a critical juncture through which to secure future business. Looking only at the segment of the ESCO market served by companies for whom energy efficiency is a core business, the top four companies accounted for 40 percent of business in 2008, thus showing less consolidation than the more diversified players presented above in the "large ESCO market." The three largest of these "small ESCO market" companies (Caroli Giovanni Energy Service Company with 17 percent market share in 2008, Berica Impianti with 8.8 percent, and Pianeta with 6.4 percent) work mainly with private sector clients, especially in the residential sector. The fourth largest (Consorzio ABN A&B Network Sociale, with 2.5 percent market share) focuses on the public sector, where it works with local and regional administrations.[570]

Sabbatucci and Labanca (2009) find that the two groups described above, the larger ESCOs and smaller ones, do not compete much with each other but rather compete within their respective groups. Breaking down the ESCOs by type of service areas, they found that in heating services, there are five to six large international operators and 50 to 100 small, local ones. For efficiency of electricity production, they found less than ten ESPs, all of which are in the "core business in energy efficiency" category. For efficiency in the lighting categories, they found a few dozen ESPs, all of which are in the "core business in energy efficiency" category. They similarly found a few dozen ESPs, all energy efficiency focused, working in the efficiency of electrical drives area. In the "final uses of heating" service category, they found hundreds of companies involved, but very few in the area of heat recovery systems.[571]

Associations: The two major ESCO associations in Italy are: (1) AGESI, which has about 30 large companies as members and (2) ASSOESCO, which has about 30 small and medium sized enterprises and consultants as members. Other relevant associations are: (3) FEDERESCO, which is a group of 50 local organizations working in areas related to energy efficiency, and (4) AssoEGE, an association of certified energy experts.[572]

[569]Nathalie Sabbatucci and Nicola Labanca, 2009, op. cit.
[570]Nathalie Sabbatucci and Nicola Labanca, 2009, op. cit.
[571]Nathalie Sabbatucci and Nicola Labanca, 2009, op. cit.
[572]Paolo Bertoldi et al, 2014, op. cit.

Drivers and barriers of the Italian ESCO and non-ESCO ESP Markets: The main drivers of the ESCO and non-ESCO ESP markets in Italy are growing demand side interest in energy efficiency and EU and Italian policies. The economic crisis, on the other hand, had a negative impact on the ESCO sector, particularly because of the leading role of public sector projects, which were affected by budget cuts. Italy's legal framework and relevant certifications serve as drivers for the industry. In addition, credit lines and other financial mechanisms promote the market, as does active promotion and awareness raising.[573]

Policy: The EU's energy efficiency policy framework is a major driver and provides the legislative foundation of all energy efficiency work in Italy.[574] Yet, while Italy has a relatively developed legislative framework and certification system for ESCOs, a range of credit lines, and strong awareness activity, some analysts feel the development of the Italian ESCO industry is not what it could be. The main criticism is that the supportive policies and mechanisms favor the large players, which, as has been discussed, serve only a portion of the addressable client base. It has been suggested that ESCO and contract definitions in the legislative framework need to address a wider range of types of companies, so that smaller companies can successfully be involved. There is also a need to improve the legal basis for verification and performance guarantees. Yet, overall, the legislative framework in Italy, and particularly its white certification mechanisms, is a main driver of ESCO industry development in the nation. The white certificate mechanism is related to projects qualifying under government requirements for a number of gas and electricity suppliers to achieve a certain level of energy savings annually. Certificates obtained for implementing energy efficiency projects may be sold to the suppliers so that they may meet their targets. Italy has a specific regulation for ESCO performance based contracting, which provides a definition of an ESCO as "a service company that offers contracts, guarantees energy savings, and participates in the financial risk of operations." The legislation further defines energy service contracts and "energy service plus" contracts. Standards for ESCOs were issued in 2010 and are expected to increase credibility in the market. The standards were being revised in 2013. Minimum certifications for ESCOs require capabilities in EPC contractual agreements and energy management systems. [575]

Financing of Italian ESCO Projects: Difficulties in financing ESCO projects is considered a barrier to the ESCO industry's development in Italy. Financing is in particular a problem for small and medium sized ESCOs, making it difficult for them to compete with the large ESCOs on large projects and to see the realization of some small project. Banks tend to lack the interest and expertise to finance ESCO projects. They require collateral for loans and will not allow guarantee based on projected EPC revenue streams. ESCO projects, in the end, are financed by a range of sources, especially ESCO equity and commercial bank loans. ESCO equity is important in heat service contracts and thus likely part of the reason large companies dominate large projects in this area. Commercial banks are slowly getting more involved in ESCO financing, though accessing credit is still a challenge for small and new ESCOs. Regional funds for projects are sometimes available, but are sporadic. Tax credits for energy

[573]Paolo Bertoldi et al, 2014, op. cit.
[574]Communication with Rod Janssen, Dec. 2015, op. cit.
[575]Paolo Bertoldi et al, 2014, op. cit.

efficiency and thus ESCO projects exist (a 65 percent tax credit for building refurbishment and 20 percent for new efficient engines and inverters in the industrial sector), but there are contradictions that need to be resolved. In particular, energy services are subject to 20 percent VAT, while simple equipment purchase has 10 percent VAT. The white certificate mechanism is a positive force for the ESCO industry as it allows project owners to gain extra profits via selling their achieved energy savings. An area about which there has been much discussion is the creation of a national fund to guarantee commercial bank loans for energy efficiency projects. While such a fund has not yet come to fruition in Italy, experts suggest it to be a good solution to the key challenge of ESCO difficulty in obtaining commercial bank loans for projects.[576]

Sabbatucci and Labanca (2009) noted at the time of their writing that, compared to other white certificate schemes in Europe, the Italian one seemed to be the only one to include in its design specifics to support the business of ESCOs. It allowed the ESCOs themselves to receive the white certificates, the selling of which could then serve as an additional source of income for them. Yet, while a large number of white certificates had been issued for ESCO projects at the time of their writing, Sabbatucci and Labanca (2009) questioned whether the program really stimulated projects that would not happen otherwise. They found that the measures so far implemented under the scheme were some of the cheapest and easiest to implement (e.g. installation of compact fluorescent lights, low flow showerheads, solar water heaters, etc.) and thus concluded the certificates, while providing extra cash flow for ESCOs, had not really been a driver for projects that would not have occurred otherwise.[577]

[576]Paolo Bertoldi et al, 2014, op. cit.
[577]Nathalie Sabbatucci and Nicola Labanca, 2009, op. cit.

6.3 United Kingdom

The United Kingdom ESCO sector has its own special history and its own terminology emerging from that history. The terms "ESCO," "EPC," and "ESC" (energy supply contract), in fact, were not well-known in the UK until recently. Instead, the UK uses the term "Contract Energy Management" (CEM). Yet, terminology aside, it was the UK Association for the Conservation of Energy that did the initial work around 1983-1984 to bring the modern ESCO concept from US to Europe.[578] The UK's CEM market has a long history and is one of the more mature in Europe, though experts suggest it still has a "niche" nature without widespread use and could benefit from further development and expansion. Like a number of other ESCO markets in Europe, the UK market began with energy supply services, in the UK usually hot water and steam. This happened in the late 1960s when a company under the UK's National Coal Board set up a subsidiary to provide management of clients' boiler houses. After a history of acquisitions and mergers, this company still exists as the nation's largest ESCO, Dalkia. Soon after it was set up in the late 1960s, other companies began to provide operation and management of central coal-fired boiler houses as well. This work was not focused on cutting costs through reduction in energy use, but rather on reducing efforts of the client company by outsourcing operation and management of boiler rooms.[579]

With influence from the emergence of the ESCO business in other countries, in 1984 the first UK ESCO providing financing and guaranteeing energy savings, along with the more standard function of providing energy supply services, emerged. This was EMSTAR, a subsidiary of the multinational oil company Shell. Shell was testing in the UK market the business model of investing its own money to: (1) upgrade the heating plant in multi-unit dwellings, (2) change the fuel (often from coal to gas), and (3) guarantee cost savings via reduced energy bills. The concept worked; and soon thereafter the oil company British Petroleum launched its own CEM doing the same things.[580]

Overall UK ESCO Market: No available estimates of annual UK ESCO or ESP market volume were identified. Experts suggest that the annual market *potential* for ESCOs in the UK is about €1 billion for the non-residential sector.[581]

Types of contracts: Sources indicate that both ESC (energy supply contracts) and EPC are common in the UK market. Also, in the EPC segment, which is growing, both shared savings and guaranteed savings occur. At the same time, energy supply contracts (ESC) in the form of the traditional UK-style heat supply contracts, dominate the market. BOOT contracts also occur in the UK market.[582]

[578]Communication with Rod Janssen, Dec. 2015, op. cit.
[579]Paolo Bertoldi et al, *European ESCO Market Report 2013*, EU Joint Research Center's Institute for Energy and Transport, 2014.
[580]Shirley Hansen, Pierre Langlois, and Paolo Bertoldi, *ESCOs Around the World: Lessons Learned in 49 Countries*, 2009.
[581]Paolo Bertoldi et al, 2014, op. cit.
[582]Paolo Bertoldi et al, 2014, op. cit.

Type of clients: According to the EU JRC (2014), the most advanced sectors of the UK ESCO market are public buildings, education, and healthcare facilities. Commercial buildings are also considered an active market segment.[583] Hansen et al (2009) note that the UK, in contrast to some other European countries, did not begin its ESCO industry with public sector projects, but has more recently developed projects in this sector. The health and hotel sectors, with their shortage of investment capital and need to provide power and hot water 24 hours per day, have been a good market for the UK's ESCOs. Multi-unit residences have the same draws as hospitals and hotels and, indeed, are the area in which the UK's ESCO market developed most strongly at first. The industrial sector also appears to be a profitable one for UK ESCOs.[584]

Types of projects: Areas that are popular for UK ESCO projects due to their profitability include HVAC, public lighting, and energy conversion and supply technologies, including district heating and cooling. Recent price decreases in equipment contribute to profitability of such measures. Indoor lighting with LEDs is also popular, as large savings that are easy to guarantee is possible. External wall insulation is still considered too expensive to be profitable for UK ESCOs.[585]

UK Industrial Sector ESCO Market: As mentioned, the industrial sector is a segment in which UK ESCOs are active. Hansen et al (2009) break this segment down into: (1) supply of reliable and cost competitive heat, power, and compressed air; (2) space heating and hot water demand for the building envelope (building applications); and (3) industrial processes. They find at the time of their writing (2009) that the UK ESCOs active in the industrial sector had been successfully addressing the first two areas, but had not gotten involved in industrial processes, due to complexity. Interestingly, two of the three UK ESCO case studies they offer include ESCO-financed installation of CHP systems for food industry manufacturers, one producing sugar syrups and the other biscuits.[586]

UK ESCOs: The EU JRC (2014) estimates that there are 30 to 50 ESCOs active in the UK market, an increase over 2009, when the number was estimated to be 20. One of their sources indicates that 17 UK ESCOs were offering EPC in 2010.[587] Langlois et al (2013) estimate that there are eleven ESCOs that are the main ones in the UK, but also a number of smaller companies (some ESCOs and some non-ESCO ESPs) serving smaller clients, such as single commercial premises, private homes, etc. For these "smaller clients," the annual energy bill is less than USD80,000. The smaller ESCO or non-ESCO ESP companies are usually set up by consultants, who have in some way acquired a means of financing to implement ESCO projects. The smaller companies do not always provide the full range of ESCO services, such as guarantees and operations and maintenance. Interestingly, some operations and maintenance companies have seen opportunity in the market and extended their services to include ESCO projects. Some consolidation has been noted in the UK ESCO industry, with smaller companies being taken over by larger ones.[588]

[583]Paolo Bertoldi et al, 2014, op. cit.
[584]Shirley Hansen et al, 2009, op. cit.
[585]Paolo Bertoldi et al, 2014, op. cit.
[586]Shirley Hansen et al, 2009, op. cit.
[587]Paolo Bertoldi et al, 2014, op. cit.
[588]Pierre Langlois and Shirley Hansen, *World ESCO Outlook*, 2013.

As for the large companies (or the ESCOs that are subsidiaries of large companies), a range of company types appears to be involved. The EU JRC (2014) notes that the main players in the UK's ESCO market have continued to be large international manufacturers of building automation and control systems, as well as energy service and supply contractors. Facility management companies are also fairly strong in the market. In addition, a number of construction and property companies have entered the UK ESCO market. A recent phenomenon is the entry of utility companies into the UK ESCO market. These major suppliers of energy see ESCO services as a way to differentiate themselves and add value, so as to keep their current customers and attract new ones. Some municipalities have also entered the ESCO sector, sometimes on their own and others with joint venture partners. Lastly, recently the UK has generated some interesting examples of environmentally minded community ESCOs.[589]

Associations: Some of the various trade associations in the UK have ESCO arms. The most known to represent ESCOs is the Energy Services and Technology Association (ESTA), which is a group of about 120 members focused on demand side energy efficiency in buildings, building services, and process services. They have a "Contract Energy Management Group" that is focused on the ESCO market and has 14 members. The Energy Managers Association (EMA) is also a positive force in developing the UK ESCO market. It consists of persons and companies in the energy management business.[590]

Drivers of UK ESCO Projects: The drivers in the UK market are mainly market demand for energy efficiency due to both environment and cost motivations. For some companies, public image is also a motivation. Policy drivers includes both legal requirements to reduce energy use and financial incentives for those that do so.[591]

Policy: Compared to many other countries, the UK Government has provided much less in the way of specific legislative or financial support for promoting the ESCO industry. The attitude has been relatively *laissez faire*, assuming the market will do this job. At the same time, there have been more recent pushes for the public sector to utilize ESCOs, in part so that private funds rather than funds from public budgets can be used to provide the up-front financing for projects.[592]

Specific regulations on ESCOs, however, such as standard contracts, do not exist in the UK market. Some suggest this actually has the benefit of creating more fluidity in the market for various types of contracts and projects, which serve as market experimentation of sorts. At the same time, the UK's very strong climate and energy conservation policy, including stringent targets, serves as a positive driver to its ESCO industry. Associated measures, including financing incentives (e.g. feed-in tariffs and the renewable heat incentive), capital

[589]Paolo Bertoldi et al, 2014, op. cit.
[590]Paolo Bertoldi et al, 2014, op. cit.
[591]Paolo Bertoldi et al, 2014, op. cit.
[592]Shirley Hansen et al, 2009, op. cit.

grant programs (e.g. a fund for local energy assessments), finance programs, and low-carbon obligations (such as low-carbon building regulations) can all benefit ESCOs.[593]

Financing of UK ESCO Projects: UK ESCOs tend to have access to a source of capital for financing. Thus, most projects are financed either via ESCOs' own funds or via private sector lenders.[594] There has been some improvement in commercial financing in the UK of ESCO projects, as the banks become more familiar with such projects and see them as less risky. At the same time, as in other countries, there is a still a problem that cash flow of the EPC cannot be used as a guarantee for the loan so that collateral is required instead.[595]

[593]Paolo Bertoldi et al, 2014, op. cit.
[594]Shirley Hansen et al, 2009, op. cit.
[595]Paolo Bertoldi et al, 2014, op. cit.

6.4 EU Energy Service Provider Related Policy and Programs

Since an initial initiative in 1988, the European Commission has continued to promote the ESP and more specifically the ESCO industry via legislation, programs, and financial mechanisms. The Commission issued two standard types of ESCO contracts, one for buildings and one for industry, in 1996. A number of other measures were adopted in ensuing years as well. This sub-section will review the current EU framework for promoting ESPs, particularly ESCOs, from the angles of: (1) legislation, (2) programs, and (3) financing mechanisms that are currently or recently active. These EU measures for promoting ESPs and energy efficiency projects work in conjunction with country-specific measures that are adopted by individual member countries.

EU Energy Service Provider Related Policy: At the center of European legislation relevant to the ESP and more specifically the ESCO industry is the *Energy Efficiency Directive* (2012/27/EU). This Directive was proposed in June 2011 and entered into force in December 2012. Member states were required to meet a deadline of June 5, 2014 in their passing of appropriate implementation measures. The Directive presents legally binding measures to ensure that member states increase efforts to use energy efficiency. The Directive contains a number or provisions relevant to ESPs and particularly to ESCOs and EPCs. The key ESP-related requirements for member states are specified in Article 18 of the Directive, the text of which is provided Exhibit 6-3.[596] Among the key requirements are: (1) disseminating information on energy services contracts and on the clauses that should be included in them; (2) providing a list of qualified or certified energy service providers (ESPs); (3) promoting energy service provider projects in the public sector; (4) providing a qualitative review in the member state's National Energy Efficiency Action Plan on, *inter alia*, the current and future development of the energy services market; (5) taking measures, as needed, to remove regulatory and non-regulatory barriers to EPC and other energy efficiency services business models; (6) enabling market intermediaries to promote the energy services industries; and (7) ensuring that energy distributors, distribution system operators, and retail energy sale companies do not take actions to impede the demand and delivery of energy services.

In addition to the direct requirements regarding ESPs in Article 18, other aspects of the *Directive* may serve as drivers of the ESP market by promoting energy efficiency among potential clients of ESPs. Most important among these is Article 7, which is entitled "Energy Efficiency Obligation Schemes." The Article mandates that member states adopt energy efficiency obligations for certain energy companies. The list of companies required to meet the obligations will be determined by the member state.[597] The overall targets are to be met by the end of 2020; and the intermediary annual energy savings targets for these companies should be no less than 1.5 percent of their energy sales to customers. Included in the text of Article 7 and recognizing the potential role of ESPs in the energy efficiency obligation schemes is the requirement that member states "permit obligated parties to count towards their obligation certified energy savings achieved by energy service providers or other third parties."

[596]Paolo Bertoldi et al, *European ESCO Market Report 2013*, EU Joint Research Center's Institute for Energy and Transport, 2014.
[597]Paolo Bertoldi et al, 2014, op. cit.

Exhibit 6-3: Key ESCO-related Requirements of the EU Energy Efficiency Directive (2012/27/EU)

Energy Efficiency Directive (2012/27/EU) - Article 18: Energy Services
1. Member States shall promote the energy services market and access for SMEs to this market by: (a) disseminating clear and easily accessible information on: (i) available energy service contracts and clauses that should be included in such contracts to guarantee energy savings and final customers' rights; (ii) financial instruments, incentives, grants, and loans to support energy efficiency service projects; (b) encouraging the development of quality labels, inter alia, by trade associations; (c) making publicly available and regularly updating a list of available energy service providers who are qualified and/or certified and their qualifications and/or certifications in accordance with Article 16, or providing an interface where energy service providers can provide information; (d) supporting the public sector in taking up energy service offers, in particular for building refurbishment, by: (i) providing model contracts for energy performance contracting which include at least the items listed in Annex XIII; (ii) providing information on best practices for energy performance contracting, including, if available, cost-benefit analysis using a life-cycle approach; (e) providing a qualitative review in the framework of the National Energy Efficiency Action Plan regarding the current and future development of the energy services market. 2. Member States shall support the proper functioning of the energy services market, where appropriate, by: (a) identifying and publicizing point(s) of contact where final customers can obtain the information referred to in paragraph 1; (b) taking, if necessary, measures to remove the regulatory and non-regulatory barriers that impede the uptake of energy performance contracting and other energy efficiency service models for the identification and/or implementation of energy saving measures; (c) considering putting in place or assigning the role of an independent mechanism, such as an ombudsman, to ensure the efficient handling of complaints and out-of-court settlement of disputes arising from energy service contracts; (d) enabling independent market intermediaries to play a role in stimulating market development on the demand and supply sides. 3. Member States shall ensure that energy distributors, distribution system operators and retail energy sales companies refrain from any activities that may impede the demand for and delivery of energy services or other energy efficiency improvement measures, or hinder the development of markets for such services or measures, including foreclosing the market for competitors or abusing dominant positions.

Article 5 of the Directive is also a potential driver of the ESP market. Article 5, entitled "Exemplary Use of Public Buildings," requires the renovation of three percent per year of total floor space of heated and/or cooled buildings owned by the member state's national government. If possible, member states should choose their least efficient buildings for renovation first. The Article explicitly recommends energy management systems, energy audits, and the use of ESPs. Selected quotes from the text of this article are as follows: "Member states shall encourage public bodies to:… put in place an energy management system, including energy audits, as part of the implementation of their plan; use, where appropriate, energy service companies, and energy performance contracting to finance renovations and implement plans to maintain or improve energy efficiency in the long term…"

Other aspects of the Directive also may serve to promote ESPs. These include Article 19, ("Other Measures to Promote Energy Efficiency"), which calls for removal of accounting and other barriers to use of EPC in the public sector. Article 20 ("Energy Efficiency National Fund, Financing, and Technical Support") requires member states to set up financing facilities (or use existing ones) for energy efficiency projects.[598] Article 8 requires states to "promote the availability to all final customers of high quality energy audits which are cost-effective." And, it requires states to "develop programs to encourage SMEs to undergo energy audits and the subsequent implementation of the recommendations from these audits." While audits may be carried out in-house, this article will most likely promote the expansion of the ESPs' audit business. Finally, the *Directive* requires member states to develop National Energy Efficiency Plans and national energy savings targets. These initiatives will in general improve the environment for ESPs and their confidence that their business is in line with the long-term goals of their governments.[599]

In addition to the 2012 *Energy Efficiency Directive*, other EU legislation of interest includes: (1) the *End-use Efficiency & Energy Services Directive (2006/32/EC)*, (2) *Energy Performance of Buildings Directive (2010/31/EU)*, and (3) European standard *EN 15900:2010*. The 2006 *End-use Efficiency & Energy Services Directive* is considered an important starting point for promoting ESPs. Yet, the it did not result in as extensive results in the use of ESPs (and associated energy savings) as hoped, so that the 2012 Directive takes further measures and readdresses some of the ones mentioned in the 2006 Directive.[600] The 2010 *Energy Performance of Buildings Directive* is the main EU legislation for reducing energy use in buildings. The general requirements of the Directive should promote opportunities for ESPs. In particular, Article 11 of the Directive calls for the establishment of Energy Performance Certificates for Buildings, which are known to promote opportunities for ESCOs.[601] The 2010 European standard for energy efficiency services (*EN 15900:2010*) is meant to serve as a reference document on "appropriate qualification, accreditation and/or certification schemes for providers of energy efficiency services." The standard is also meant to "provide guidance to both customers and providers of energy efficiency services… and to contribute to the development of a market for energy efficiency services."

EU Programs Related to ESPs: The EU JRC (2014) points out a number of recent and current EU programs related to the promotion of ESPs. These are listed below with description:

1. The EU Energy Performance Contracting Campaign (EPCC): The EPCC was launched in 2012 under the European Commission's DG Energy. The goal of the campaign is the increase and improve the use of EPC via country-specific dialogue and capacity building. Seminars are organized in various cities across the EU. The program makes available training materials, guidance documents, and best practice case studies.[602]

[598]Paolo Bertoldi et al, 2014, op. cit.
[599]Paolo Bertoldi et al, 2014, op. cit.
[600]Paolo Bertoldi et al, 2014, op. cit.
[601]Paolo Bertoldi et al, 2014, op. cit.
[602]Paolo Bertoldi et al, 2014, op. cit.

2. The Covenant of Mayors (CoM): This program, or "movement," involves local authorities voluntarily committing to increased energy efficiency and use of renewables to achieve a 20 percent reduction in carbon dioxide emissions by 2020. Promotion of ESCOs is offered as a key action to be taken to achieve the target.[603]

3. Intelligent Energy Europe (IEE): This program has funded a large number of projects that promote EPC, mostly in the private sector. It has now been replaced by Horizons 2020. Outputs under IEE include EPC guidance documents, proposed financing alternatives, and quality standards, and research on the links between white certificates and EPC. Other projects helped municipalities switch to energy efficient lighting and via energy services contracting. IEE has had a number of initiatives to date. Below two past initiatives are listed, as well as two ongoing ones:

- *The European Energy Service Initiative (EESI):* Making use of previously developed standards and tools for EPC and other energy services, EESI implemented training events, on-line help desks, and consultancies for applying EPC to pilot projects. The ChangeBest project under EESI conducted a series of country analyses on national energy efficiency services markets (some used as sources for this study) and various kinds of dialogues and exchange on this topic.
- *PERMANENT Project*: The PERMANENT Project focused on measurement and verification, as well as financing, of energy services contracting. The goal was to increase trust via standardized means of measurement and verification.
- *EESI2020*: With a full name of "European Energy Service Initiative towards EU 2020 Savings Targets," EESI2020 aims to address the EU 20 percent energy savings target by substantially wider use of EPC. This project is actually a continuation of EESI, with a focus on supporting large cities in integrating long-term EPC plans into their overall energy plans. Pilot projects and training are planned.
- *Transparense*: This project aims to create a European Code of Conduct for EPC and related trainings with the aim of increasing transparency and trustworthiness in EPC markets in Europe.[604]

EU Funding Sources for ESP Projects: The EU JRC (2014) has identified a number of funding sources that may be relevant to ESP projects. These include potential funds for carrying out EPC, as well as funds that may be relevant to ESPs in general in earlier phases of developing energy efficiency projects.

1. The Multi-Annual Financial Framework: The framework includes "Structural and Cohesion Funds" that have been used for energy efficiency and ESCO investments in a number of countries. The new framework (2014 to 2020) is in line with the EU 2020 strategy for "smart, sustainable, and inclusive growth" and is therefore expected to continue to support such projects.[605]

[603]Paolo Bertoldi et al, 2014, op. cit.
[604]Paolo Bertoldi et al, 2014, op. cit.
[605]Paolo Bertoldi et al, 2014, op. cit.

2. Project Development Assistance (PDA) structures of Intelligent Energy Europe: The PDA funds are meant to support local government agencies in developing bankable sustainable energy projects. There are a number of funding sources from which to select depending on the applicant (e.g. government agency, investor, or financial institution) and size of the project. These include: EIB-ELENA (large projects over €50 million), MLEI-PDA (mid-sized projects over €6 million), EBRD-ELENA (mid-sized projects less than €50 million), CEB-ELENA (mid-sized projects less than €50 million), and KfW-ELENA (mid-size projects less than €50 million. There are no deadlines.[606]

3. EEE-F (European Energy Efficiency Fund): EEE-F can be used for both project development and investments, including loans, guarantees, or equity participation for projects conducted in the public sector, including ESCO projects. The fund is managed by Deutsche Bank.

4. European Investment Bank: Recently, the EIB has been providing guarantees for ESCO projects. As referenced in some of the foregoing country case studies, guarantee mechanisms are in great need to expand commercial bank financing of ESCO projects.

- *JESSICA*: The EIB launched JESSICA in 2006 to support urban development projects. The funds can be used either as equity, debt, or guarantee investment.[607]

[606]Paolo Bertoldi et al, 2014, op. cit.
[607]Paolo Bertoldi et al, 2014, op. cit.

7. Overall Recommendations

A number of conclusions and recommendations are spread throughout the more detailed analysis of foregoing sections of this report. This section provides overall recommendations for the Government of Turkey and for Turkish companies based on the findings of this study:

1. Take a broad approach to development of energy service providers for industry, encompassing both fee-for-service and performance based models. Do not overemphasize the ESCO model at the expense of ignoring the development of other ESP company types that may be a better fit for the industrial sector: Findings in other countries suggest it would be unwise to invest the majority of available resources into promoting performance based contract models for energy service providers in the industrial sector. That is, the focus should not be on ESCOs alone and in fact it may make more sense to focus on non-ESCO options. At the same time, experience in Western countries suggests ESCOs and their performance based contracts may have a role to play in two areas within the industrial sectors: energy supply contracting (such as CHP) and building retrofitting. As for energy supply contracting, findings suggest it is the one area within the industrial sector of western developed economies that ESCOs flourish. As for building retrofitting, it should be noted that building energy consumption is a small part of total industrial energy consumption. Further, many industrial clients may feel they have the skills to retrofit their buildings on a piecemeal basis. Yet, ESCO projects addressing industrial buildings have also been identified, including for major clients such as GM. Finally, experience in Asia suggests ESCOs may have a broader role to play in industrial energy efficiency. In China, in particular, this may include provision of key energy consuming equipment for industrial processes.

2. In developing a strategy for fostering ESPs to serve the industrial sector, break down the needs of industries into the following categories and develop activities for fostering ESPs in each category: (1) cross-cutting equipment – requires ESPs with expertise in various areas such as air compressors, boiler systems, motor systems, fans, mixers, etc.; (2) industrial processes – may require ESPs with expertise in specific industrial sectors; (3) energy management systems – ESPs can be generalists, but should be talented at working with internal staff to identify energy saving activities. Candidates for each area may then be identified and targeted for outreach and training. Based on findings, the most active area for industrial ESPs in other countries appears to be the first category – ESPs specialized in various types of cross-cutting industrial equipment. Thus, this may be the best area on which to focus initially. Buildings will be a fourth area to cover, but may not require specific industry-focused skills.

3. In fostering ESPs, consider the additional strategy of outreach and training for those companies that are already providing service to industrial customers. For large manufacturers, these will be engineering companies and equipment vendors. Parallel with some of the discussion above, these providers may include (a) companies serving cross-cutting equipment needs and (b) companies specialized in industrial process of certain sectors. For small manufacturers, these providers may be companies the SMEs trust to help them with equipment repair and replacement. Many of these companies (both those serving large industrial companies and those serving industrial SMEs) may not have expertise in

energy efficiency at present. Yet, they may have receptivity to outreach and training that will help them expand the suite of services they offer to customers to include energy efficiency services.

4. In light of the incredibly rapid growth of "ESCOs" in China's industrial sector, consider the China model of promoting homegrown manufacturers of energy-saving equipment. This may not be a true or traditional ESCO model. Yet, it shows that, with strong subsidies and tax benefits, projects incorporating domestically developed energy saving equipment in the industrial sector can lead to very rapid growth of the "ESCO" sector. To understand whether the China model may apply in Turkey, an assessment of Turkey's level of industrial energy efficiency "low hanging fruit" may be necessary. In China, paybacks to date on many industrial energy efficiency projects have been very short, usually less than three years and often in the range of one year. This situation has allowed very rapid growth of the home-grown equipment manufacturer "ESCO" model. To see if the China experience applies to Turkey, it may be important to compare the two countries' current levels of industrial energy efficiency in various sectors. At the same time, it is important to note that China's ESCOs have focused on large industrial users rather than small ones as their market. Thus, pursuit of the "China model" may work best in addressing large industrial users rather than SMEs. Finally, one approach to consider is cooperation between stand-out Chinese ESCOs and Turkish counterparts in the Turkish market.

5. Consider a program of free or partially subsidized industrial energy audits, particular for SME industrial enterprises. Ensure that detailed guidelines are available for audits and that audit quality is monitored. Such programs in the US, Germany, and Japan have achieved high rates of implementation of audit recommendations. Yet, it's critical the program be well designed and the audits of high quality. SMEs may be particularly unlikely to proactively pursue energy audits on their own and thus the need for such programs.

6. Consider a program facilitating partnerships between large industrial companies and ESPs as a means of fostering growth and promotion of the ESP sector. Publicizing the program will be important. Such a program may be best developed as a component of another program targeting large energy users. ESPs may be drawn to join the program by benefits of publicity, such as being listed on the program website and being allowed to use the program logo and advertise their involvement. This is the model being used by USEPA in the industrial "partnering" component of their Energy Star Program.

7. If refinement of Turkey's ESP certification program is desired, consider reviewing the systems recently designed in other countries. Findings from the report suggest that many countries have just recently designed (or updated) their ESP related certification programs. In the US, existing programs were found to be unsatisfactory as certification was generally issued to all who completed the relevant training program without regard to capabilities. The newly launched program (including a Certified Practitioner of Energy Management Certification, CP EnMS) focuses more on a test of capabilities and is developed in conjunction with a program providing technical assistance to large industrial enterprises.

8. Recognize that SME industrial facilities and large industrial users may require different strategies and programs for developing ESPs to serve them. To address issues of energy efficiency in industrial processes of SMEs, consider outreach to lean manufacturing programs and/or development of sector-specialized programs for clusters of SMEs. Another strategy may be to have EMS experts work with internal staff to identify energy saving opportunities. The type of ESP suited to SMEs may be different than the type of ESP suited to large industry. It may be useful to recognize this in developing programs to foster ESPs. Programs may have different strategies for fostering ESPs for small industrial SMEs than they have for fostering ESPs to serve large industrial companies. Further, improving energy efficiency in the industrial processes of SMEs is considered an underserved area in most countries. To address the gap, one strategy to consider is to incorporating energy efficiency into lean manufacturing programs. This may involve fostering energy efficiency know-how among lean manufacturing experts. Another strategy used in some countries is to develop programs providing sector specific energy efficiency know-how to clusters of companies working in the same sector. A third strategy is to have EMS experts work with internal staff to identify energy saving opportunities.

9. Consider leveraging various drivers that have promoted the ESCO and ESP industries in other countries. These may include:

- Leveraging of donor financing for demos and for promotion of ESCO financing in the banking sector: Donor financing has proven especially effective in (a) the launch of demo ESP projects (with donor providing preparatory funds and end user providing implementation funds, as in the case of Thailand) and (b) promoting the financing of ESCO/ESP projects (as in the case of China, where donor efforts of working with the banks after many years have led to new loan products that allow partial guarantee of ESCO loans through project revenue flows).
- Development of standards and methods for monitoring and verification of results of industrial energy efficiency projects
- Ensuring that policies treat ESCO implemented projects equally to host-implemented projects
- Preferential tax treatment for energy efficiency projects and ESCOs
- Subsidies, funds, and/or white certificates to support energy efficiency projects, including ESCO projects: Italy may be an interesting case to review further with regard to tailored policy promoting ESCO involvement in white certificate projects.