Energy Services in Shanghai

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Abstract

The People’s Republic of China (PRC) is one of the fastest growing economies in the world. However, the economic expansion is not without complications. Improved standard of living and a growing industrial sector have led to an increased demand of energy, which in turn is contributing to air pollution and land contamination.

The research problem of the study is what is keeping existing Energy Services (ES) in Shanghai from being used more frequently. To answer this, a sequential mixed method study is conducted, divided into a qualitative and quantitative part. The literature study indicates a great potential for ES in Shanghai. This is mainly due to great efforts taken in Energy Efficiency (EE), an attempt to face the rapidly increasing population by reducing the usage of energy. A number of barriers for ES are found throughout the existing literature, including market, financial, institutional as well as technological barriers.

To further investigate barriers and opportunities on the ES market in Shanghai, 14 semi-structured interviews with relevant stakeholders and academics were conducted. Hypothesizes were formulated based on results from the interview and literature study as well as an expert panel. To test the hypotheses a questionnaire was sent out to real estate developers in Shanghai.

This study discovers the need of bringing several in the literature identified barriers to ES in Shanghai up to date. Some barriers were found to be invalid while others were not identified at all. The newly found barriers include market barriers, such as ES having low priority, poor
technological understanding among clients, and complications approaching and communicating with potential clients. For institutional barriers, it was found that the prevalence of low margins in the Chinese industries is holding back stricter regulations. Furthermore, the Energy Service Companies’ (ESCO) lack of understanding of ES from a system perspective is considered a technology barrier.

In addition to the barriers, a number of opportunities were found. Improved communication between real estate stakeholders and ESCOs contribute to greater awareness and knowledge, which in turn leads to a higher degree of investment in ES. Differentiation of the services offered by ESCOs may attract new customers who previously were not interested, e.g. companies with short investment horizon. In Shanghai, there are a significant number of subsidies, regulations and laws favoring ES. Moreover, the rapid growth of Shanghai is considered one of the greater opportunities.

To conclude, it was found that the maturity level among ESCOs in Shanghai was having large impact on the overall usage of ES. Fixed barriers, i.e. barriers nearly impossible to overcome, together with the large amount of small and inexperienced ESCOs is found to be hindering ES in the Shanghai commercial real estate sector from being used more frequently.
Sammanfattning


Studiens problemformulering är vad det är som hindrar befintliga energitjänster i Shanghais byggnadsektör från att användas oftare. För att svara på denna fråga använde s en sekventiellt multidisciplinär metod uppdelad i en kvantitativ och kvantitativ studie. Utifrån litteraturen är det uppenbart att det finns en stor potential för användning av energitjänster i Shanghai. Främst till följd av stora satsningar på energieffektivitet i ett försök att möta den snabbväxande befolkningen med högre krav på levnadsstandard genom att minska energianvändningen. Ett antal hinder existerar emellertid inom Shanghais energitjänstemarknad. Inom dessa inkluderas allt ifrån marknads- och finansiella problem till institutionella och teknologiska komplikationer.

För att vidare undersöka vilka problem och möjligheter det finns för energitjänster i Shanghai genomfördes 14 semi-strukturerade intervjuer med involverade aktörer och akademiker i Shanghai. Baserat på resultatet från intervjuerna tillsammans med litteraturstudien och en expert panel formulerades hypoteser härörande energitjänstesituationen. För att testa hypoteserna genomfördes en enkätundersökning riktad till fastighetsutvecklare i Shanghai.

Studien visade att många av de tidigare utpekade hindren för energitjänster i Shanghai behövdes uppdateras, varav vissa visade sig vara obsoleta och några inte gick att verifiera. Bland de
nyfunna barriärerna kan nämnas marknadsbarriärer som låg prioritering för energitjänster, låg teknisk kompetens bland fastighetsägare samt svårigheter för energitjänstebolag att närma och kommunicera med potentiella kunder. För de institutionella barriärerna framgick att låga marginaler inom den kinesiska industrin håller tillbaka hårdare regleringar. Inom de tekniska barriärerna framkom att energitjänstebolag generellt sett brister i deras kunskap om energitjänster som kan tillgodose hela byggnadens energisystem.

Utöver problemen identifierades även betydande möjligheter. Ökad kommunikation mellan aktörerna bidrar till större kunskap vilket i sin tur leder till en högre grad av energitjänsteinvesteringar. Genom att differentiera de tjänster energitjänsteföretag erbjuder kan de hitta nya kunder som tidigare inte varit intresserade, framförallt sådana med kort investeringshorisont. I Shanghai finns det ett betydande antal subventioneringar, regler och lagar som gynnar energitjänster. Även Shanghais tillväxt ses som en av de stora möjligheterna.

Studien kommer fram till att en låg mognadsgraden bland energitjänstebolag i Shanghai negativt påverkan användningen av energitjänster. Existensen av flera fasta barriärer, barriärer som är svåra att påverka, tillsammans med det fakta att majoriteten av energitjänstebolag är små och oerfarna ses som den främsta orsaken till att energitjänster inte används i större utsträckning i Shanghai.
Acknowledgement

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<tr>
<th>SIGN</th>
<th>DENOMINATION</th>
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<tbody>
<tr>
<td>BREEAM</td>
<td>Building Research Establishment Environmental Assessment Method for buildings</td>
</tr>
<tr>
<td>CVR</td>
<td>Content Validity Ratio</td>
</tr>
<tr>
<td>EE</td>
<td>Energy Efficiency</td>
</tr>
<tr>
<td>EFS</td>
<td>Effect Size</td>
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<tr>
<td>EMCA</td>
<td>ESCO Committee of China Energy Conservation Association</td>
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<tr>
<td>EMCo</td>
<td>Energy Management Companies (ESCO in PRC)</td>
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<td>EPC</td>
<td>Energy Performance Contracting</td>
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<tr>
<td>ES</td>
<td>Energy Service</td>
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<tr>
<td>ESCO</td>
<td>Energy Service Company</td>
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<tr>
<td>ESGB</td>
<td>Evaluation Standard for Green Buildings</td>
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<tr>
<td>EU</td>
<td>European Union</td>
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<tr>
<td>FM</td>
<td>Facility Management</td>
</tr>
<tr>
<td>FYP</td>
<td>Five-Year Plan</td>
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<tr>
<td>GBL</td>
<td>Green Building Label</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GhG</td>
<td>Greenhouse Gas</td>
</tr>
<tr>
<td>HSCW</td>
<td>Hot Summer – Cold Winter</td>
</tr>
<tr>
<td>HSWW</td>
<td>Hot Summer – Warm Winter</td>
</tr>
<tr>
<td>IBE</td>
<td>Institute for Building Efficiency</td>
</tr>
<tr>
<td>kWh</td>
<td>Kilo Watt Hour</td>
</tr>
<tr>
<td>LEED</td>
<td>Leadership in Energy and Environmental Design</td>
</tr>
<tr>
<td>MOF</td>
<td>Ministry of Finance</td>
</tr>
<tr>
<td>MOHURD</td>
<td>Ministry of Housing and Urban-rural Development</td>
</tr>
<tr>
<td>NDRC</td>
<td>National Development and Reform Commission</td>
</tr>
<tr>
<td>REA</td>
<td>Real Estate Agent</td>
</tr>
<tr>
<td>PRC</td>
<td>People’s Republic of China</td>
</tr>
<tr>
<td>RMB</td>
<td>Currency in the PRC: Renminbi</td>
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<tr>
<td>SEA</td>
<td>Swedish Energy Agency</td>
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<tr>
<td>SOE</td>
<td>State-Owned Enterprise</td>
</tr>
<tr>
<td>SP</td>
<td>Senior Person According to Qualitative Study</td>
</tr>
<tr>
<td>SP2</td>
<td>Senior Person According to Quantitative Study</td>
</tr>
<tr>
<td>tce</td>
<td>Tonne Coal Equivalent</td>
</tr>
<tr>
<td>URCTC</td>
<td>Shanghai Municipal Urban and Rural Construction and Transportation Commission</td>
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<tr>
<td>USGBC</td>
<td>U.S. Green Building Council</td>
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<tr>
<td>WB</td>
<td>World Bank</td>
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## List of Symbols

<table>
<thead>
<tr>
<th>SIGN</th>
<th>MEANING</th>
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<tbody>
<tr>
<td>(\alpha)</td>
<td>Significance Level</td>
</tr>
<tr>
<td>(m^2)</td>
<td>Square Metre</td>
</tr>
<tr>
<td>(N)</td>
<td>Sample Size</td>
</tr>
<tr>
<td>(n_e)</td>
<td>Number of Panelist Choosing <em>Essential</em> or <em>Important</em></td>
</tr>
<tr>
<td>(p)</td>
<td>Probability</td>
</tr>
<tr>
<td>(z)</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>(\delta)</td>
<td>Accuracy</td>
</tr>
<tr>
<td>(d)</td>
<td>Cohen’s d</td>
</tr>
<tr>
<td>(\hat{p})</td>
<td>Estimated Probability</td>
</tr>
<tr>
<td>(\theta_{ACTIVE})</td>
<td>Number of Active Real Estate Development Companies</td>
</tr>
<tr>
<td>(\theta_{TOT})</td>
<td>Total Number of Real Estate Development Companies</td>
</tr>
<tr>
<td>(\beta)</td>
<td>Probability of Making a Type II Error</td>
</tr>
<tr>
<td>(\chi^2)</td>
<td>Chi Square Distribution</td>
</tr>
<tr>
<td>(\phi)</td>
<td>Cramer’s phi</td>
</tr>
<tr>
<td>(\bar{X})</td>
<td>Mean of Population X</td>
</tr>
<tr>
<td>(\bar{Y})</td>
<td>Mean of Population Y</td>
</tr>
<tr>
<td>(r)</td>
<td>Pearson’s Product Moment Correlation Coefficient</td>
</tr>
<tr>
<td>(z_x)</td>
<td>Standard Deviation of X</td>
</tr>
<tr>
<td>(z_y)</td>
<td>Standard Deviation of Y</td>
</tr>
<tr>
<td>(x)</td>
<td>Rank of x</td>
</tr>
<tr>
<td>(y)</td>
<td>Rank of y</td>
</tr>
<tr>
<td>(\bar{x})</td>
<td>Mean Rank of x</td>
</tr>
<tr>
<td>(\bar{y})</td>
<td>Mean Rank of y</td>
</tr>
<tr>
<td>(\rho)</td>
<td>Spearman’s Rank Correlation Coefficient</td>
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1 INTRODUCTION

Shanghai has become a booming metropolis. For the last six years the region has enjoyed a strong economic growth topping eight percent on average (IMF, 2010). The growth has caused the metropolis to be under constant economic, social and environmental change. As such, the city has to face a multitude of challenges, none the least pressure to develop infrastructure and housing (UN, 2004).

Along with the development of buildings arise the task not only to offer housing and office space for everyone, but also to build in a sustainable fashion. It is recognized by the central committee of the People’s Republic of China (PRC) that energy conservation is of outmost priority. This was displayed in both the 11th and 12th Five-Year Plan (FYP) of the PRC which stated energy conservation to be of national priority. Unless the targets are met, the economy will be faced with dire consequences. Consequences fueled by the increased demand and production cost of coal. Also, global emission of Greenhouse Gases (GhG) is closely linked to the PRC’s energy usage. As of 2012, PRC is one of the main emitters of GhG globally. (KPMG, 2012)

By examining the energy usage in the building sector, amounting for 30 percent of the total energy usage in the PRC, it becomes evident that much can be done by addressing energy conservation. Especially when considering that PRC’s energy intensity is one of the highest in the world (IEA, 2010) which hint that a large potential exist for improvements, see chapter 4.4 about energy intensity.

Just by looking at the technical potential of Energy Services (ES) in buildings, one would say that the potential is huge. However, evidence show that this potential has not been captured. Therefore, the scope in this thesis is to take a broad stance on the market and identify contingencies that prohibit the technical potential to be reached in the PRC’s ES market and what opportunities that exist.

1.1 Background to the study and why it is important
The authors of the thesis realized the absence of Energy Efficiency (EE) among Shanghai’s building stock by sheer observation. This was done during previous studies at the Hong Kong University of Science and Technology and Fudan University in 2011-2012. It was observed how buildings where bleeding energy through their building envelope. The authors questioned why this was the case? Why are the buildings not built in a more sustainable fashion?

From 1992 to 1994 a large case study was conducted in the PRC with the support of the World Bank (WB) and the Global Environment Facility. The study concluded that great energy conservation potential existed in the market with a large number of energy projects with economic and environmental benefits, but these projects had not been implemented at that time due to market obstacles. (World Bank, 2008)
With continuous government support from financial subsidies and implementation of tax policies, together with support policies from local governments and financial products from commercial banks, the future markets looks promising for Energy Service Companies (ESCOs). By 2015, the PRC is planning to implement a mature ES system which will further expand the number of ESCOs and strengthen the capacity of existing companies. (IFC, 2012)

This thesis was initiated by presenting the observations made in Shanghai together with a thesis proposal to a mayor technological consultancy firm based in Sweden. For this company, the study and its results could prove useful as it would give them a deeper insight in the ES situation in the PRC which could help in a future expansion. The study aims to improve the current field of research and could also be a starting point for future research in the field.

1.2 Past research in the field of study

Previous research into the PRC’s ES market has shown to lack proper examination of local ES market such as Shanghai. Rather the results have been generalized to the whole PRC without investigating if local differences would affect conclusions and recommendations. This is true for Xu, Chan & Qian (2011) who investigated success factors for Energy Performance Contracting (EPC) in retrofit projects of Chinese hotels by interviewing academics, hotel managers and projects managers from construction companies. Zhang, Li & Shouli (2011a) investigated problems and countermeasures for EPC in the PRC. Li & Colombier (2008) investigated institutional and economical barriers for building EE in the PRC. Hu & Zhou in 2011 published a conference paper examining engineering risks associated with EPC in the PRC faced by ESCOs, and Da-li (2009) who published a conference paper in 2009, investigating barriers and removal measures for ESCOs operating in the PRC.

Another deficiency in the literature is found in the data collection, with data typically being gathered from one or two actors, normally ESCO companies. At the same time conclusions are drawn for the whole ES market, leading to low validity in the result. In a recent publication from 2013, Kostka & Shin investigating the importance of trust for the success of operating an ESCO in the ES market in the PRC. The study relied on semi-instructed interviews of ESCOs, energy experts and representatives from the ESCO committee of China Energy Conservation Association (EMCA). While only a few actors in the market were studied, conclusions were drawn for the whole ES market in the PRC. Another study by Xu et al. in 2013 investigated barriers to energy audits in six provinces but was limited to the view of ESCOs without considering other actors.

The maturity level of the PRC’s ES market, which began in 1998, is in a rapid stage of development which quickly is causing literature in the field to become obsolete. Recent implementation of local and national policies such as changes to the Energy Conservation Law in 2010 and the new 12th FYP in 2011 may have had great impact to the ES market. What might have been a barrier to ES market development in the past three years may have changed completely by today. An example is the 91 percent increase of registered ESCOs from 2009 and 2011. Giving an indication to the rapid market change experienced in the ES market (EMCA, 2012). Therefore, results from previous studies should be verified before being used.
As a consequence, studies relying on data before 2011 such as Vine (2005) who compared the ES market in several countries and drew conclusions regarding barriers in the ES industry for each country may be outdated. Especially since only 23 ESCOs were active in 2001 compared to 2011 when 2339 ESCOs were registered according to EMCA (2012). A similar case can be made with an assessment of ESCOs worldwide by Ürge-Vorsatz et al. from 2007 which identified barriers to the ES market in the PRC based on data collected in 2003-2007.

Hence the need for this study can be motivated by:

- The importance of ESCOs for the PRC to reach energy conservation targets in the 12th FYP and to accomplish a decrease in global GhG emission
- The scarcity of studies conducted in the PRC on the ES market
- The lack of studies focusing on local ES markets such as Shanghai
- The rapid change occurring in the ES market in Shanghai
- The lack of a studies collecting data from a comprehensive set of ES market actors

1.3 Research problem and purpose of study
The purpose of this study is to evaluate problems facing the use of ES in the Shanghai commercial real estate sector. To fulfill the purpose of the study it is needed to investigate potential barriers, problems and issues facing ESCOS in the Shanghai commercial real estate sector. Therefore, the research problem pursued in this report is:

What is hindering currently available energy services in the Shanghai commercial real estate sector from being more frequently used?

To answer the research problem two research questions were formulated:

1. Which actors play an important part in the ES market?
2. What is important or lacking for the development of the ES market in Shanghai?
   a. ESCO barriers
   b. ESCO opportunities

The study is limited to the geographical area of Shanghai and therefore the findings may not reflect the situation faced in other provinces’ ES markets. Furthermore, the study is focusing on the ES market for commercial buildings, both new constructions and retrofit projects. ES directed towards the residential and industrial real estate market are outside the focal point of this study. However, some elements regarding these may be touched to give a broader understanding of the market as whole. Also, the study is investigating the current situation of the ES market as of 2013. Since the market is changing rapidly, trends may be short lived even if found significant in this study.

1.4 Structure of the paper
In the following chapter the mixed method approach used in the paper is presented. The paper is then divided into two sequential studies:
1. A qualitative study presenting empirical material and result from a literature study and semi-constructed interviews held in Shanghai.
2. A quantitative study drawing on the conclusions from the qualitative study and formulating hypothesis tested with a questionnaire.

In the final chapters, findings from the qualitative and quantitative study are analyzed and conclusions drawn.
2 METHOD

Due to the gaps found in previous studies conducted in the PRC exploring the ES market, see chapter 1.2, it was not possible to solemnly use existing literature in the effort to an answer to the research questions. Therefore, to eventually draw specific conclusions about the ES market in Shanghai, a broad and up to date investigation of the ES market was needed to give answer the research questions. As a result this study employs the grounded theory concept. The grounded theory concept is built upon a systematic methodology; first relevant data spanning the ES market is collected followed by analysis extracting important concepts. The concepts form the basis for formulation of results or hypothesis, assisting to answer the research problem.

A sequentially driven mixed-method structure was decided as a method to ensure the quality of the research. The mixed-method utilizes both qualitative and quantitative approaches to analyze data and integrate the findings. (Tashakkori & Creswell, 2007)

The first stage of the study is exploratory and gathers data to be analyzed qualitative through semi-constructed interviews and a literature study. The outcome of literature study is compared to the outcome of the interview study. The goal of the first stage is:

To gain insight into the ES in Shanghai and develop constructs and propositions to be further tested in an in-depth Quantitative survey.

In the second stage of the study a quantitative method is used, see chapter 8 on page 84. Findings from the qualitative study are converted into constructs and used for hypothesis testing with the purpose to give an answer to the research questions.

To bridge the results from the first study a validity test is applied, see chapter 3.3. In the test a panel of experts was poised to evaluate the findings from the qualitative study and give indication to which findings were most important for the ES market in Shanghai.
3 QUALITATIVE STUDY METHODOLOGY

The qualitative study was designed into three main parts: A literature study, an interview study and an expert panel to verify the findings from the first two parts and assess their validity and impact to the ES market in Shanghai. Several methods of triangulation are used in the qualitative study to give validity to the findings, such as the use of different data sources, the use of multiple investigators in the analysis process and multiple methods.

3.1 Literature study methodology

Data from published journals, books, government websites and publications and institutions was used as a secondary source of data collection in the qualitative study. The different sources meant that the literature study’s validity could benefit from data triangulation (Denzin, 2006). An extensive study of available literature was done. Due to the rapid growth in the ES market in Shanghai, as well as the recent changes in policies and regulations issued by the local and central government affecting the ES market, a restrictive selection of sources were made regarding their publication date.

The literature study emphasized on data with direct or indirect connection to the geographical area of Shanghai. Findings may therefore not reflect the situation faced in other provinces’ ES markets. ES directed towards the residential and industrial real estate market are outside the focal point of this study. However, some elements regarding these may be touched to give a broader understanding of the market as whole.

3.2 Interview study methodology

The use of semi-constructed interviews was used as the primary source of data collection in the qualitative study. All interviews were conducted in Shanghai during three weeks in April 2013. The unit of analysis for the interview study was Senior Persons (SP) with in-depth knowledge of the ES market in Shanghai.

INFOBOX A: Senior Person (SP)

The criteria for a SP were determined to:

- Minimum of three years of work/academic experience
- Senior/Managerial position in a company or academic with a Ph.D degree or higher

SPs were drawn from actors involved in the operation of ES or academic experts specializing in energy and buildings in Shanghai. The sample frame was stratified into seven main strata:
ESCO, Architects, Developers, Academics, Investors, Facility Management (FM) and Governmental Institutions. In Figure 1, each stratum is visualized in the context of the ES market.

![Figure 1](image)

*Figure 1 Visualization of the qualitative study’s sample frame in the context of the ES market in Shanghai*

Main actors in the ES market in Shanghai were identified prior to the interview sessions and summarized in an actor map, see Figure 9 on page 24. The actor map served as a reference point for selecting the actors in Figure 1. Entailing the main actors involved in the ES market in Shanghai in the sample allowed for data triangulation in the interview study, which according to Denzin (2006) can enhance the validity of the study and its outcome.

### 3.2.1 Sample identification

The practice of snowball sampling was used to identify the interviewees and draw a sample from the sample frame. The use of snowball sampling was motivated by the difficulty existing in conducting research in the PRC. According to (Roy, Walter & Luk, 2001; Peng & Nunes, 2008; Manion, 1994) the main challenges are:

- **A1** Identifying a representative and reasonable sample in the PRC due to its large size, number of potential respondents, inhomogeneous country with rival cultural, ideological, political and economic systems of Confucianism, Marxism and Capitalism

- **B1** Obtaining an accurate contact list for the selected sample due to incomplete, inaccurate, not up-to-date lists, difficulty to access lists from authorities due to secrecy and low incentives to give out the information

- **C1** Translating questionnaires and contact the sample due to language barriers

- **D1** To overcome non-responses and unreliable responses caused by the respondents concerns about secrecy
(A1) and (B1) meant that a typical sample frame in the PRC acts as a hidden population. Snowball sampling was adopted to overcome this obstacle. The benefit of snowball sampling is its ability to identify groups or persons that are difficult to find by conventional means, such as from a company directory covering an industry e.g. the yellow pages or a national classification list. (Watters & Biernacki, 1989)

INFOBOX B: Snowball Sampling

In snowball sampling a few informants referred to as zero-stage respondents are identified and approached prior to the execution of the sampling. When the zero-stage respondent participates in the study he or she is encouraged to recommend suitable interviewees known as chain referrals. As the event unfolds the sample builds as the referrals suggest participants.

Source: Vervaeke et al., 2007; Biernacki & Waldorf, 1981

In Figure 2 the main principle of snowball sampling is presented, the number signifies how many referrals the respondent reached i.e. how deep the chain evolved. One cluster as shown in Figure 2 is referred to as a subgroup.

When applying snowball sampling, one need to be careful and monitor the introduction of bias arriving from the zero-stage respondent. According to Biernacki and Waldorf (1981) the zero-stage respondent and chain referrals are likely to create a subgroup with similar characteristics. To better reflect the population one should strive to gain data from several subgroups (Biernacki & Waldorf, 1981). In this study, the portion of zero-stage respondent was made large in relationship to the total sample size. By increasing the portion of zero-stage respondent, the introduction of bias and influence from each zero-stage respondent was minimized.
A high success rate of identifying zero-stage respondent was accomplished by using a contact network established by the researchers prior to the study. 14 informants were initially contacted with a 100 percent response rate. However, four informants were excluded for not meeting the criteria of a SP. Having established contacts meant it was not only possible to contact possible interviewees through a personal email or telephone, but also possible to refer to a person which they already have an established relationship with. This helped to alleviate some of the respondents’ secrecy/trust concerns (D1).

A random sampling technique was introduced to complement for the ESCO-strata due to the low amount of zero-stage respondents initially reached within the ESCO-strata. A list from the NDRC issued in 2011, see Appendix A, including all approved ESCOs operating in Shanghai was used as a sample frame to draw random samples from. The list included 35 companies. Ten random samples were drawn, of which two companies accepted an interview. To further expand the amount of zero-stage respondents, a visit to the Shanghai Eco Design Fair the 13th of April 2013 was conducted at which three ESCOs were present. All three ESCOs were approached by the researchers at the fair, one agreed to be interviewed. In Table 1 a breakdown of the strata and the distribution of chain referrals during the study are shown.

<table>
<thead>
<tr>
<th>Strata</th>
<th>Zero-stage respondent</th>
<th>Chain referrals</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Developer</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Investor</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Architect</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Energy Service Companies</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Governmental Institutions</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Facility Management</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>7</td>
<td>7</td>
<td>14</td>
</tr>
</tbody>
</table>

3.2.2 Sample size
A total of 13 in-depth personal interviews were conducted as well as one email questionnaire. When conducting quantitative research it is often not viable to use probability mathematics to estimate a required sample size to reach a valid result. A common practice is to use the technique of saturation. In theory saturation means that at one point, new data collected does not give much new information. When this happens, the collected data is likely to reflect the population. A weakness is the subjective interpretation whether or not the data has become saturated (O’Reilly & Parker, 2013). In Table 2, the distribution of interviews in the seven strata is presented as well as the level of saturation in the strata responses based on the researchers judgment.
Table 2 Distribution of interviews for each strata showing saturation level reached, number of interviewees and interview length

<table>
<thead>
<tr>
<th>Actor/Strata</th>
<th>Saturation</th>
<th>Number of interviewees</th>
<th>Interview length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic</td>
<td>High</td>
<td>5</td>
<td>02:55:49</td>
</tr>
<tr>
<td>Developer</td>
<td>Low</td>
<td>1</td>
<td>00:40:01</td>
</tr>
<tr>
<td>Investor</td>
<td>Low</td>
<td>1</td>
<td>00:48:35</td>
</tr>
<tr>
<td>Architect</td>
<td>Low</td>
<td>2</td>
<td>00:43:53</td>
</tr>
<tr>
<td>Energy Service Companies</td>
<td>High</td>
<td>5</td>
<td>03:18:02</td>
</tr>
<tr>
<td>Facility Management</td>
<td>-</td>
<td>0</td>
<td>00:00:00</td>
</tr>
<tr>
<td>Governmental Institutions</td>
<td>-</td>
<td>0</td>
<td>00:00:00</td>
</tr>
<tr>
<td>Total</td>
<td>-</td>
<td>14</td>
<td>08:26:20</td>
</tr>
</tbody>
</table>

It was noted that a high level of saturation was discovered among the data within the ESCO-strata and the Academic-strata. However, among the Developer-, Architect- and Investor-strata the number of interviews could not justify a high level of saturation. For the FM- and Governmental Institution-strata, no interviews were conducted and that is why saturation was not reached within these strata.

3.2.3 Cultural and language barriers
Since the study was conducted in Shanghai, PRC, which is not the region native to the researchers challenges from cross-language/culture research were faced. The language barrier can be especially cumbersome and inhibit reliable data from the interviews. As a countermeasure, researchers often employ local translators. This in turn can lead to several issues that may decrease the trustworthiness and quality of the study. According to Squires (2009) several issues need to be considered when employing an interpreter:

A2 Keeping the conceptual equivalence during the translation concerns the challenge in translating the spoken word from one language into another language while retaining the underlying message
B2 Ensuring translator and interpreter credentials that can give credibility to the translated work
C2 Stating the role of the translator or interpreter during the research process prior to the research
D2 Validating the translated work of an interpreter by employing some type of quality check to enhancing the rigor of the study

To overcome the challenges from point (A2), (B2) & (C2), hiring a local interpreter was done prior to the interviews. An advertisement was put up at Fudan University’s internal job platform on the 14th of Mars 2013. The poster was available in both Putonghua and English and gave a description of the project, the role of the interpreter, work time, requirements and salary. A total of 17 qualified applicants were received during one week of screening. To ensure that the
interpreter has sufficient skills (B2) to be part of the study a predefined selection criterion was set up:

- Previous interpreting/translator experience
- Certificates of interpreting/translation
- Level of English and Putonghua (written/spoken)
- Level and field of degree
- Previous experience with ES
- Availability during the interview sessions

Three candidates were selected for a final round of interviews performed over Skype. This was performed to test the interpreter’s interaction (A2) with the researchers during a simulated interview. Prior to the actual interview sessions began, the interpreter was briefed in detail about the project.

During the study the main tasks of the interpreter/translator was to:

- Contact possible interviewees by phone in Putonghua
- Translate emails to Putonghua (C1)
- Interpreting during interviews held in Putonghua - (3) interviews
- Assisting during interviews when translation was needed (C1) (10) interviews
- Taking notes during the interviews (13) interviews
- Participate a discussion after interviews
- Transcribe recordings from interviews held in Putonghua (C1)

3.2.4 Contact with sample

The interpreter assisted when contacting possible interviewees. It was noted that contacting interviewees was difficult when communicating in English. Getting past the receptionist was seldom possible. Therefore, contact efforts made by phone would be held in Putonghua. However, contact by telephone would rarely result in an interview unless the name of a SP in the company or organization was known.

Contact efforts were also made by email. Nearly all emails inquiring for an interview was successful and led to an interview when they were conveyed to a person the respondent knew. The content of the emails, see Appendix B, were carefully designed and sent in both English and Putonghua (C1).

Non-responses or unwillingness to perform an interview were always contacted by telephone to investigate if they constituted a source of bias. The most frequent response would be that no person in the company could fit the profile of a SP or that no SP had time for an interview. However, non-responses seemed mostly to be determined by whether or not a contact existed between the researchers and the respondent. Non-responses or unwillingness to participate in an interview was not found to be more or less pronounced due to group property, the size of company, local or regional affiliation or strata which could point to a biased set of data.
3.2.5 Data gathering
All interviews had a predefined set of areas covered during an interview. The researchers would explain the purpose of the study, as well as give a brief definition of ES and ESCOs. This was put into practice to ensure that the interviewees and interviewer were sharing the same ES and ESCOs concept. All interviewees were recorded with an electronic recorder if consent was given by the interviewee. All questions were deliberately asked as open-ended questions giving the interviewee the opportunity to express their own opinion. The interviewees were encouraged to expand on their answers and follow-up questions were frequently used.

Two researchers were always present during an interview session. One researcher would be responsible to direct the conversation while the second researcher took frequent notes and asked follow up questions if something was unclear or needed to be further explained. One interpreter was always present during the interviews. At the beginning of an interview the interviewee had the option to continue the interview in English or Putonghua. If the interview was conducted in English the interpreter would help to explain some concepts if something were unclear to the researchers or to the interviewee. The interpreter would also take notes during the interview. At the end, the interviewee was handed a small gift bag, see Appendix C.

The interviewee would be asked if he/she knew any relevant contact the researchers could use in their research. After each interview session the researcher and interpreter discussed the session and compiled notes. One day after the interview, an email was sent to the interviewee thanking them for their time and again asking if they were able to recommend a contact.

3.2.6 Data coding
The recording from each interview session was transcribed to two separate documents in Microsoft Word. One document was transcribed by the interpreter and one by the researchers. The transcribing was performed word by word and the two documents were later combined together. If the transcribed documents differed, the researchers and interpreter would replace it with the most accurate sentence. This strategy was implemented to minimize the introduction of random errors while coding the data (D2) which according to Swab and Sitter (1974) can amount to about 2–4 percent of the transcribed content. Furthermore it allows for investigator triangulation by having several investigators present in the analysis process. (Denzin, 2006)

3.2.7 Data analysis
Data analysis was facilitated by the use of QSR nVivo 10 software. Transcripts from each interview were imported into the software. Two researchers worked independently and coded important sentences from the transcripts into nodes. Each node was given a name that represented its content. All the important fragments from the interviews were coded into nodes. Nodes identified were compared and discussed between the researchers and resulted in a combined list of nodes.

Discriminating analysis was used to analyze the similarity of the nodes content. Visual representation and discriminating analysis facilitated the effort of summarizing the data into main points.
3.3 Expert panel methodology

In an effort to connect the result of the qualitative study to a quantitative study, results from both the qualitative study and the literature study were compared. Hence, potential barriers for the ES market in Shanghai were drawn using methodical triangulation. According to Norman K. Denzin (2006) methodical triangulation is one of four methods involving triangulation to enforce the validity of a study’s results. (Denzin, 2006)

Following the argument in chapter 1.2, on page 2, the rapid development of the ES market in Shanghai require extra care when relying on results from studies conducted in the past. What was a barrier a few years ago may not be one today. Also, investigating barrier for their relative impact on the ES market in Shanghai would benefit the study. Therefore the result from the qualitative study needed to be further verified.

The result from the interview study, see chapter 6.3, was tested for its content validity by an expert panel, a methodology developed by C. H. Lawshe (1975). This allows for investigator triangulation by presenting each expert the same statements which they rate for its importance to the ES market in Shanghai (Denzin, 2006). The impact of each statement could be rated as:

- a) Essential
- b) Important but not essential
- c) Not important
- d) I do not know

All (d) answers were filtered from further calculations. Using equation (3.1) formulated by C. H. Lawshe, where \( N \) stands for the total number of panelist and \( n_e \) the number of panelist choosing Essential for the statement (Case A) or Essential and Important but not essential for the statement (Case B). Each statement could be given a Content Validity Ratio (CVR):

\[
CVR_i = \frac{n_e - (N/2)}{N/2}
\]  

(3.1)

The CVR value is compared to a critical CVR value. The critical CVR value is a measure for which it is probable that the statement is viewed as Essential or Essential/Important by the actors in the ES market in Shanghai. According to the work by Wilson, Pan & Schumsky (2012) approximation of a critical CVR value to a discrete binominal distribution can be assumed. The test was used under a confidence value of \( \alpha = 0.05 \) for a one-tailed test. Using the function \( n_{critical} = CRITBINOM(N, p, 1 - \alpha) \) in Microsoft Excel the minimal number of panelist choosing the statement as (a) or (b) could be determined with a corresponding critical CVR value, see Table 3.
Main points from the qualitative study were operationalized prior to the content validity test, see Appendix D.

3.3.1 Sample identification
The sample frame used in the content validity test was the same as in the qualitative study, see Figure 1 on page 8. The sample size was determined to 14 SP. The sample was selected with non-probability sampling and drawn from the list of interviewees interviewed in the qualitative study. Using interviewees from the qualitative study in the sample was motivated by the difficulty of gaining responses from informants if no relationship with them existed a priori the contact effort. A relationship was already established with the interviewees from the quantitative study and a high response rate was expected.

3.3.2 Data collection
An electronically distributed questionnaire was used as primary data gathering instrument. Google Form was used to compile, distribute and handle the data from the responses. The questionnaire contained statements, operationalized version of the qualitative study’s main points. In total 23 multiple choice questions were included in the questionnaire, see Appendix E.

3.3.3 Contact with sample
Each questionnaire was embedded in an email, see Appendix B, and sent to the sample. The design of the email followed guidelines set by Dillman (1978) to receive a high response rate, see Appendix F.

Non-responses and follow-up of responses was done in two steps. After one week, a reminder was sent out by email thanking everyone for their participation and encouraging those who had not completed the questionnaire to fill it in. After another two weeks, a final reminder was sent out to those who had not responded the survey. Bellow, in Table 4, responses and response rate is presented during a five week period.

Table 3 Minimal required number of panelist viewing the statement as Essential, Case A, or essential or important, Case B, for the view to be significant at a significance level of $\alpha=0.05$ and the corresponding critical CVR value

<table>
<thead>
<tr>
<th>No. of Panelist</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min Value</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>8</td>
<td>9</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Min CVR</td>
<td>0.60</td>
<td>0.67</td>
<td>0.71</td>
<td>0.50</td>
<td>0.56</td>
<td>0.60</td>
<td>0.45</td>
<td>0.50</td>
<td>0.38</td>
<td>0.43</td>
</tr>
</tbody>
</table>

Table 4 Development of response rate and total number of respondent participating in the Expert Panel during three stages

<table>
<thead>
<tr>
<th>Stage</th>
<th>Responded</th>
<th>Not Responded</th>
<th>Response Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert Email</td>
<td>5</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td>First Reminder</td>
<td>5</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td>Final Reminder</td>
<td>6</td>
<td>8</td>
<td>43</td>
</tr>
</tbody>
</table>
3.3.4 Data analysis
Data from the responses was exported to Microsoft Excel and analyzed with equation (3.1), see page 14. Each statement was arranged after their CVR score, ranking their significance to the ES market in Shanghai. Statements were tested with the essential criteria (Case A) and important criteria (Case B).
4 LITERATURE STUDY

The following literature study is meant to give the reader understanding of the market situation in the PRC and to give an update of the current research within the field.

4.1 Energy situation in the PRC
The PRC is one of the fastest growing economies in the world. Because of this, the demand for energy is steadily increasing. Between 2001 and 2011 the energy usage have had an annual growth rate of 8.3 percent. During the same time period, the GDP grew by an average of 10.48 percent every year. By the end of 2011, the energy usage reached 3.48 billion tonnes coal equivalent (tce), more than any other country in the world. For the PRC to accomplish a balanced and prosperous society by 2020, the modes of economic development and the efficiency in energy utilization must be improved. (IFC, 2012)

If building site energy usage in PRC grows to current US levels, the PRC’s energy usage will be four times higher compared to today. This is problematic as the PRC is already facing difficulties supplying its population with sufficient energy. There are new power plants being built at several locations all over the country and it is done at a time when global warming is at the top of the agenda and the consequences of global warming, both globally as well as locally, have only yet begun. Energy efficient buildings are one way of increasing the energy usage efficiency and thereby slowing global warming. (WBCSD, 2007)

To improve EE, the PRC has specific policies where market oriented mechanisms play an important role. EPC has an important role in the three major energy savings related policies. EPC is also one of the major energy saving initiatives mentioned in the twelfth FYP, where high priority is given to support further development of the ESCO industry. (IFC, 2012)

4.2 Global perceptions of energy efficiency
The Institute for Building Efficiency (IBE), the International Facility Management Association and the Urban Land Institute conducted a survey about Energy Efficiency Indicators 2012 together with 16 in-country partners. The survey drew almost 3500 respondents and was focusing on six regions and was distributed in four languages. The survey was aimed at building owners, FM, public institutions and global executives with responsibility for energy management and investment decisions.

Globally in 2012, 85 percent of the respondents said energy management was very or extremely important to their organizations, compared to 70 percent in 2011 and 60 percent in 2010. In the PRC, 81 percent of the respondents indicated that they were going to increase investments in EE and renewable energy in the coming year, see Figure 3. (IBE, 2012)
Across the surveyed regions, energy cost saving was the main driver for investing in EE; see Table 5. Increasing energy security was the second most important driver in the PRC as well as in Europe. PRC was the only surveyed region to name existing policies as a main driver. (IBE, 2012)

Table 5 Drivers for EE investments. Source: IBE, 2012

<table>
<thead>
<tr>
<th>Drivers of Efficiency</th>
<th>Europe</th>
<th>India</th>
<th>The PRC</th>
<th>US/Canada</th>
<th>Australia</th>
<th>Brazil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy cost savings</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Government /utility incentives/rebates</td>
<td>3</td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
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<tr>
<td>Enhanced brand or public image</td>
<td>2</td>
<td>3</td>
<td></td>
<td>3</td>
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<tr>
<td>Increasing energy security</td>
<td>2</td>
<td>3</td>
<td>2</td>
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<tr>
<td>Greenhouse gas reduction</td>
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<td>3</td>
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<tr>
<td>Existing policy</td>
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<td></td>
<td></td>
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<td>3</td>
<td></td>
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<tr>
<td>Increasing asset value</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>3</td>
</tr>
</tbody>
</table>

4.3 Climate zones
The PRC has an area of about 9.7 million km², making it the third largest country in the world. Being situated between the Pacific Ocean and Eurasia creates a climate where monsoons are able to develop in the southern parts of the country. The monsoons give rise to change of wind direction between winter and summer as well as seasonal variation of precipitation. The PRC has a complex topography including regions with large flat desert plains to vast areas of icy mountains. The features of the different areas mean that the country has a large diversity of climates, from subtropical zones in the south to both warm- and cool-temperate in the north. (Yang, Lam & Tsang, 2008)
There are several ways to categorize the diverse climate zones according to different criteria, which largely depend on the purpose of the classification. In the PRC, when it comes to the thermal design of buildings, a classification with five major climate types is used according to the national ‘Standard of Climate Regionalization for Architecture’ GB 50178-93. (U.S. Department of Energy, 2011)

The different zones are categorized into seven categories: (I) Severe Cold, (II) Cold, (III) Hot Summer - Cold Winter (HSCW), (IV) Hot Summer - Warm Winter (HSWW), and (V) Mild. The zones are drawn as shown in Figure 4. The criteria for the zones are mainly based on the average temperature in the hottest and coldest months of the year (Yang et al., 2008). The coldest and hottest mean monthly temperatures during a year determine the types of climate zones, which can also be seen in Figure 4. (U.S. Department of Energy, 2011)

4.3.1 Climate zone building design
The PRC has developed three zone dependent national design standards for residential buildings. One standard exist for the zones categorized as severe cold or cold, one for zones categorized as HSCW and one for zones categorized as HSWW. The different standards are used in energy efficient design of new construction, additions and retrofits of existing buildings. (U.S. Department of Energy, 2011)

4.3.1.1 Design standards in severe cold and cold zones
Energy usage in building in the cold and severe cold zones is dominated by space heating, especially during the coldest months of the year. In 2010, a design standard (JGJ 26-2010) was issued, which required residential buildings to be 65 percent more energy efficient than residential buildings built in the 1980s. The two cold zones were also further divided into five
smaller zones to be able to tailor a more local thermal performance of the building envelope. (U.S. Department of Energy, 2011)

4.3.1.2 Design standards in hot summer and cold winter zones
Shanghai and its surroundings are one of the most densely populated areas in the PRC and are situated in a HSCW zone. When the economy started growing rapidly in the middle of the 1990s, so did the demand for the air condition and space heating, immensely increasing the energy demand. In 2001, the PRC issued residential building codes (JGJ 134-2001) stating that newly built houses has to be 50 percent more energy efficient compared to early 1980s levels. When the 2010 version (JGJ134-2010) was released, many assumed that the 50 percent would rise to the 65 percent in the cold zones. However, this was not the case as the developers of the standard believed that the effective implementation of the 50 percent target was more important and reachable considering the current level of technology and local conditions. (U.S. Department of Energy, 2011)

4.3.1.3 Design standards in hot summer and hot winter zones
In 2003, the PRC issued a standard (JGJ 75–2003) for residential buildings in the HSWW zone in which it was divided into two sub regions. The northern region has both a cooling and a heating need while the southern only has a cooling need. The aim of the standard is to reduce the energy usage of Heating, Ventilation and Air Conditioning (HVAC) by 50 percent compared to buildings without a measurement of energy saving. This is done with a mixture of mandatory and voluntary provisions related to energy performance of the HVAC system and thermal performance of the building envelope. (U.S. Department of Energy, 2011)

4.4 Energy intensity
Energy intensity is the energy consumed per unit of economic output, Gross Domestic Product (GDP). It is one of the most important energy indicators of China according to Wang (2011), energy intensity also mentioned as an improvement entity in the FYPs. Energy intensity is influenced by many factors such as the general living standard and condition of an economy. (IFC, 2012)

From Table 6 it is apparent that the energy intensity is decreasing every year, meaning that more GDP is produced per unit of energy used. In the period 2005-2010, the total reduction of energy intensity reaches 18.95 percent. In the same time, the GDP had risen with 115 percent while the total energy usage had increased with 38 percent. (Wang, 2011)
Table 6 Energy intensity and energy intensity reduction rate in the PRC. Source: Wang, 2011

<table>
<thead>
<tr>
<th>Year</th>
<th>GDP (billion RMB)</th>
<th>Total energy usage (100 million tce)</th>
<th>Energy intensity (tce/10 000 RMB with 2005 price)</th>
<th>Energy Intensity reduction rate based on previous year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>18,493.74</td>
<td>23.6</td>
<td>1.276</td>
<td>-</td>
</tr>
<tr>
<td>2006</td>
<td>21,631.44</td>
<td>25.87</td>
<td>1.241</td>
<td>2.74 %</td>
</tr>
<tr>
<td>2007</td>
<td>26,581.03</td>
<td>28.05</td>
<td>1.179</td>
<td>5.04 %</td>
</tr>
<tr>
<td>2008</td>
<td>31,404.54</td>
<td>29.14</td>
<td>1.118</td>
<td>5.20 %</td>
</tr>
<tr>
<td>2009</td>
<td>34,090.30</td>
<td>30.66</td>
<td>1.077</td>
<td>3.61 %</td>
</tr>
<tr>
<td>2010</td>
<td>39,798.30</td>
<td>32.5</td>
<td>1.032</td>
<td>4.18 %</td>
</tr>
</tbody>
</table>

The energy intensity in the PRC during 2010 was 1.032 tce/10 000 RMB which equals 7.298 tce/10 000 USD with 2005 currency levels. The energy intensity in 2010 for Sweden was 1.553, Japan was 1.320, Taiwan was 2.999 and North America was 2.163 tce/10 000 USD (EIA, 2013). For Shanghai, the corresponding value was 5.196 tce/10 000 USD during 2010. (Shanghai Statistical Yearbook, 2011)

4.5 Building sector

The building sector in the PRC is divided into residential and non-residential subsectors. The non-residential sector is further divided into industrial and commercial buildings. This is illustrated in Figure 5. Commercial buildings are in the literature often referred to as Public buildings. However, in order to avoid confusion, all department stores, supermarkets, office buildings, hotels, restaurants, banks, post offices, airports, rail station, education buildings and communication services and similar are referred to as commercial buildings in this study.

![Diagram of building sector in the PRC.]

Shanghai is a fast growing city as is visualized in Figure 6. The non-residential building stock has grown from 133 million square meters in 2000 to 410 million square meters in 2010, which equals to a growth of 208 percent. The yearly relative growth rate of new buildings in Shanghai in 2010 is 5 percent for residential buildings and 9 percent for non-residential buildings. (SMHSBAB, 2011)
A large amount of money is put into the expansion of the Shanghai building stock. In the end of year 2009, the value of unfinished contracts signed before 2008 reached a total of 313 billion RMB and the value of contracts signed in 2009 reached 439 billion RMB. (SMHSBAB, 2011)

4.5.1 Commercial building energy usage in Shanghai
With the economic growth in the PRC, the percentage of governmental offices and large commercial buildings is rapidly increasing, thus the impact of their energy usage has grown drastically. The government of the PRC has shown increased awareness of this issue, especially in large commercial buildings such as high-end office buildings and shopping malls. Less than 4 percent of the total floor area arrives from large commercial buildings, yet they represent roughly 20 percent of all building energy use. (MOHURD, 2007)

In a paper by Xu et al. in 2013, the energy usage in commercial buildings in Shanghai is analyzed. When comparing governmental office buildings to public office buildings, it was found that the average energy usage per m² per year was between 50 kWh/m² and 100 kWh/m² in the PRC. No data was found to support the common perception that governmental buildings waste more energy compared to private buildings. (Xu et al., 2013)

Shanghai is one of the more economically developed zones in the PRC and therefore has higher comfort standards compared to many other regions and are thus also using more electricity. In Figure 7 the monthly electricity use in office buildings is shown, peaking during the hot summer in July. Even though the weather in February, March and April is becoming increasingly hot, the electricity use was almost unchanged in office building during these months. (Xu et al., 2013)
Figure 7 Monthly office electricity use in Shanghai. Source: Xu et al., 2013

Figure 8 shows the breakdown of the offices, hotels and shopping malls buildings total energy usage per square meter and year in Shanghai. As can be seen, lighting and equipment is where most of the energy is used for these types of buildings. Cooling and heating only stands for a small percentage of the total energy usage in offices as well as hotels. However, the trend is that more energy is used for cooling and heating as the comfort demand is rising as the PRC becomes more economically developed. (Xu et al., 2013)

Xu et al. (2013) concludes that building size has no correlation with the building energy usage; large buildings are equally efficient as smaller buildings. Moreover, modern buildings built in the 1990s and 2000s had the same level of energy usage as older buildings. However, the comfort level in modern buildings is generally higher compared to older buildings. (Xu et al., 2013)

4.6 Actors in the real estate development sector
Analysis of key actors in the real estate development sector in the PRC was made by Kong, Lu & Wu (2012) as well as the World Business Council for Sustainable Development (WBCSD, 2007), and includes some of the main actors. Figure 9 gives an overview of the below described actors.
Developers

In new buildings, it is the real estate developers who have the most influence in the implementation of renewable technologies which is sometimes used as a selling point. Compared to the high housing prices in developed cities, the incremental cost of energy technology is not too much. Real estate developers are not only initiating new EE projects; they are also part in the retrofit of existing buildings. (Kong et al., 2012)

Designers

Designers and architects take care of the planning and designing of the building, and work together with both developers and ESCOs. (WBCSD, 2007)

Energy service companies

An ESCO aims to provide a series of EE technologies and services to improve the energy situation for their client, reducing energy use and in the long run reduce costs. More information on ESCOs and their services can be found in the chapter 4.7.1 on page 26.

Contractors

The general contractors are hired by the developers and are responsible for the day-to-day oversight of a construction site. The contractor acquires materials from equipment suppliers and work closely together with both ESCOs and developers. (WBCSD, 2007)

Materials & equipment suppliers

Contractors and developers buy various products from EE product manufacturers. The equipment produced by these companies is EE products and renewable energy technology such as heat pumps, air conditioning equipment, insulation etc. The EE product manufacturing industry in the PRC has been flourishing with the new financial and tax incentives coming into effect with the 11th and 12th FYP. (Kong et al., 2012)
Capital providers

Loans are given by financial institutions, such as commercial banks. Based on the 11th FYP, banks are to support the funding of building EE in order to slow down the increased use of energy in the PRC. However, retrofit building EE projects have had less success in obtaining bank support as they have a lack of an approved profit mechanism (Kong et al., 2012). More about financial barriers can be found in chapter 4.13.2.3 on page 46.

Central and local government

One of the most important actors for EE implementation in buildings is the central and local governments. The administrative authority of building EE in the PRC consists of the state administrative department, e.g. Ministry of Housing and Urban- Rural Development (MOHURD) and National Development and Reform Commission (NDRC), and the local administrative department. It is MOHURD that is responsible for EE promotion and reduction of emissions in buildings. Together with other central ministries they develop EE policies and organize implementation of EE programs. The local government has the power on a local level, without their approval the local construction departments cannot issue subsidies, regulations, laws or other policies. As of 2012, many of the local governments in the PRC have not yet fully understood the importance of EE in buildings, which in turn results in few new local policies and regulations. (Kong et al., 2012)

Evaluation and third party organizations

Evaluation organizations maintain technical personnel, advanced testing instruments and corresponding evaluation techniques. These independent and objective organizations are authorized by the construction department to evaluate and assess energy performance in buildings as well as providing energy rating labels to evaluated buildings. The evaluation organizations are independent third party organizations and charge a fee for their services. The government covers these costs to promote the building EE labeling system and to evaluate the result of different services in all of the PRC’s climate zones. (Kong et al., 2012)

The buildings’ owners are often the end users according to Kong et al. (2012), and they are the ones who get to enjoy the final result of better indoor thermal conditions as well as financial benefit obtained from EE. Users with higher incomes and higher demand for thermal comfort are willing to pay more for building EE, but due to poor awareness, the potential of EE in buildings is not fulfilled. (Kong et al., 2012; WBCSD, 2007)

International organizations play an important role in the development of building EE in the PRC. The government of the PRC has an extensive co-operation with international organizations and foreign countries. In the starting phase of EE in buildings, the international organizations played an important role in helping with problem solving and technology implementation and funding. Most of the international co-operation projects are for demonstration purposes, which have only limited impact in promoting EE. (Kong et al., 2012)
4.7 Energy services
ESs have a wide range of interpretations. In this study, the definition by Strid & Bergmasth (2004) is chosen. They define it as “services related to energy usage and whose aim is to make the usage of energy more efficient”. They also mention direct and indirect ES, where indirect ES is when the companies give advice and suggestions but do not participate in the implementation. For direct ES the company is also involved in the implementation of the services, an example of this is EPC (Energimyndigheten, 2011). Bertoldi & Rezessy (2005) lists a range of activities associated with ES, both direct and indirect:

- Energy analysis and audits
- Energy management
- Project design and implementation
- Maintenance and operation
- Monitoring and evaluation of savings
- Property/FM
- Energy and/or equipment supply
- Provision of service (space heating, lighting, etc.)

**DEFINITION: Energy Service [ES]**

Services related to energy usage aiming to increase the energy efficiency and/or energy conservation of energy usage. The services include direct and indirect energy services. Indirect services cover services that give recommendations to pursue increased energy efficiency and/or energy conservation without participating in the implementation of the recommendations.

*Source: Strid & Bergmasth, 2004*

4.7.1 Energy service company
The definition of an ESCO may differ from country to country. ESCOs differ from other types of companies that offer energy equipment contractors, such as equipment contractors and energy consultants, by offering performance based contracting of various types, such as EPC (Ürge-Vorsatz et al., 2007). ESCOs therefore take a bigger risk compared to consulting firms who are typically paid a fee for their advice without undertaking the risks of failure (Okay & Akman, 2010). The EU-commission’s definition of ESCO is an organization that takes some form of financial risk during implementation of technology or improvements that lead to more efficient use of energy. (Energimyndigheten, 2011)
Since the first oil crisis in the early 1970s, the interest for EE improvements has been steadily increasing. This is due to the rapid increase of energy cost were the end-users were looking for operation cost reductions and ways to manage and monitor their energy usage. With the global warming effects, the interest in ESCO has again risen (Okay & Akman, 2010). The first ESCOs in developing countries, such as the PRC, were created in the 1990s. Today the ESCO concept has spread to most industrialized countries and to the biggest developing countries. (Ürge-Vorsatz et al., 2007)

4.7.2 Energy performance contracting

DEFINITION: Energy performance contracting [EPC]

According to the European Union’s Directive of energy efficiency (Directive 2012/27/EU), energy performance contracting is a contractual agreement between a client and a provider of EE improvement measures where investment are paid for in a pre-determined level of EE improvement or other agreed upon energy performance cratering. The process is to be verified and monitored during the whole term of the contract.

Key characteristics of EPC:

- It guarantees the energy savings and/or provision of the same level of ES at lower cost
- Its yield is directly tied to the energy savings achieved
- It can either finance, or assist in arranging financing for the installation of an energy project they implement by providing a savings guarantee

The typical business scenario of an EPC contract is shown in Figure 10. In the first scenario, before EPC, the energy cost is at its initial level of 100 percent. After various improvements have been completed, the energy usage is only 40 percent of the initial value. Part of the saving resulting from lowered energy cost is taken by the ESCO, to pay for their services, the other
part is received by the client who saves some energy costs. In the last scenario, when the contract runs out, the client takes all the profit from the decreased energy cost.

There are two main models for EPC, one is the guaranteed savings contract and the other is the shared savings contract.

### 4.7.2.1 Guaranteed savings contract

Under a guaranteed savings contract, the ESCO ensures a certain level of energy savings. The ESCO takes care of the entire design, installation and savings performance risk, but does not take care of the credit risk and the project is financed by the client. The advantage of this model is that the ESCO do not have to take care of the finance and even small companies can enter large projects. However, if the savings are not enough to cover the guaranteed savings, and thus not enough to cover debt service, then the ESCO has to cover the difference. If the savings exceed the promised level, the ESCO receives a pre-determined percentage of the savings. (Bertoldi & Rezessy, 2005)

The guaranteed savings model is hard to introduce to new markets where there is little or no knowledge of the ESCO concept because the financing part is taken care of by the client, and they are taking the investment repayment risk. (Okay & Akman, 2010)

### 4.7.2.2 Shared savings contract

Under a shared savings contract, cost savings made by energy improvements are split based on a pre-determined percentage over a pre-specified length of time. The ESCO assumes both credit and performance risk, meaning that if the client goes out of business, the investment is lost (Bertoldi & Rezessy, 2005). The ESCO may attempt to put a low estimate on the savings and then receive more money due to excess savings. To avoid risk of energy price changes, a contract of single energy price may be used. This way none of the parties will benefit from changes in energy price. (Poole & Stoner, 2003)

In developing markets, like the PRC, the shared savings concept is a good introductory model because the customers assume no financial risk, thus removing some of the trust barriers.
However, for small ESCOs, this concept is problematic because they soon become unable to get more loans and therefore cannot continue with more projects. (Poole & Stoner, 2003)

4.7.2.3 Other models
A third model that is frequently used is Europe is the *chauffage contract*, where the ESCO takes complete responsibility of an agreed set of ES. Where energy supply market is competitive, i.e. there are more than one supplier to choose from, the ESCO can be granted full responsibility of fuel and electricity purchasing. A fee is paid by the client to the ESCO and it is based on the existing energy bill, minus a percentage saving, usually around 5-10 percent. This way, the client is guaranteed immediate savings relative to its current bill. The chauffage contract usually last very long, up to 20-30 years. (Bertoldi & Rezessy, 2005)

4.7.3 Energy service companies in the PRC
In the PRC, ESCOs are sometimes known as Energy Management Companies (EMCo), and similarly with ESCOs they operate according to EPC mode (World Bank, 2008). For the ease of reading, EMCos will be referred to only as ESCOs for the remainder of this thesis. The definition by the NDRC of Chinese ESCOs is ‘a company with its core business in the energy conservation service such as energy conservation assessment, design, retrofits and operations’.

To apply for subsidies from the government, the company needs to be registered as an ESCO. In order to be registered, a company’s core business must meet a certain criteria. It shall cover energy auditing, diagnosis, design, retrofit and operation, its registered capital should exceed 5 million RMB, it should have competent technical professionals, and personnel implementing EPC projects. (IFC, 2012)

In 1998 an international collaboration between the WB, the Global Environment Facility and NDRC was initiated. It was called the ‘The PRC Energy Conservation Project’ and was divided into two phases. Phase 1, with the main objective to promote EPC and to develop ESCOs in the PRC and phase 2, with the task to provide services to the ESCOs such as loan guarantee plans, to promote the development of a new energy conservation service industry in the PRC. (World Bank, 2008)

During phase 1, three ESCOs were established which were dedicated to demonstrate capability of ESCO business models in the PRC. In the beginning the companies encountered many problems. The market was not yet ready and was not familiar with the business, and there were not sufficient legal and financial regulatory system for the businesses and some local authorities even began to declare the EPC business as illegal due to accounting problems (Xiaoliang & Lin, 2011). With the support of the central government, some of these problems were solved and the project ended up being successful as the companies managed to make profit as well as having steady growth. (World Bank, 2008)

The success of phase 1 led to the implementation of phase 2, which was implemented in 2003. At the same time, the Chinese ESCOs industrial organization EMCA was established. EMCAs purpose was to provide technical assistance and services for new ESCOs. (World Bank, 2008)
In 1998, with the implementation of phase 1, the PRC had three ESCOs. The implementation of the eleventh, and also the twelfth FYP, which both promote energy conservation has led to a rapid increase of ESCOs in the PRC. By the end of 2011 there were a total of 2339 registered ESCOs at the EMCA, see Figure 11. Almost half of them were established in 2010 and 2011. In 2011, these ESCOs employed more than 378 000 persons (IFC, 2012). It can also be seen from the figure that the EPC investment per company has steadily increased. In 2011, the total EPC investments by ESCOs in the PRC reached 41.24 billion RMB. (EMCA, 2012)

![Number of ESCOs operating in the PRC and ESCO's investment in EPC. Source: EMCA, 2012](image)

The industry sector is the most energy demanding sector in the PRC and can therefore benefit a lot from ES. The industry sector has increased its investments in EPC since 2007 and in 2010 the industry sector in the PRC made up to 82 percent of the total investments, compared to the building sector’s 15 percent, while traffic and others is 3 percent, see Figure 12 (Li, 2011). Although the industry sector invests much more on EPC, only about half of the projects are in that sector. (EMCA, 2011)
4.7.4 Energy performance contracting in the PRC

According to the ‘General Technical Rules for Energy Performance Contracting’ (National Standard GB/T 24915-2010), issued by the PRC’s National Standardization Management Committee in 2010, the definition of EPC in the PRC is as follows:

**EPC in the PRC**

An energy conservation service mechanism whereby an energy service company and energy user entity contractually agree on the energy savings target of an energy conservation project, the energy service company provides necessary services for realization of the energy savings target, and the energy user entity pays for the energy service company’s investment and reasonable profit from the energy saving results.

The PRC’s government is putting effort in the EPC mechanism and states it as an important instrument to promote energy conservation in the PRC. Due to marketing in press media, and through demonstration projects, many energy consumers such as industries or commercial building owners have shown great interest in EPC. There are also a large number of overseas companies both producing energy saving equipment and practice energy conservation consultation services that favors the PRC (World Bank, 2008). By the end of 2011, EPC project investments in the PRC totaling more than 41 billion RMB or 6.7 billion US dollars, meaning that the business volumes are on par with those of the United States. (IFC, 2012)

In the industry sector, about half of the ESCOs utilized shared savings mode while in the building sector the corresponding number was 69 percent, see Figure 13 (EMCA, 2009). Most clients prefer shared savings because the ESCO provides the financing off the client’s balance sheet and they do not have to pay the ESCO any upfront funds. However, as most of the ESCOs in the PRC are small, they do not have the financial capabilities to invest in shared savings and therefore use the alternative guaranteed savings model. (Xiaoliang & Lin, 2011)
According to EMCA’s industry survey (2012), EPC contract periods are from 3-20 years where 3-8 year contracts are the most common. EMCA also estimates that EPC periods will increase in the future as the ESCOs become more sophisticated and the most straightforward projects have already been implemented.

4.7.5 Funding for energy services

Fiscal funds are issued by the central or local government to selected enterprises or individuals. The Central government issues subsidies and reward funds for important nationwide EE programs. The local government develops supporting policies and funds to support building EE according to local conditions, see chapter 4.10.1 on page 36. The fiscal fund amount varies for different regions. In the eastern or coastal areas, such as Shanghai, the funds can be up to ten times higher compared to the western parts of PRC, such as the Yunnan province. Co-operation with international organizations can bring advanced concepts, technologies, methods and International funds to support EE development in the PRC. (Kong et al., 2012)

The fiscal funds are far from enough to cover the cost of building EE and play more of a guiding role and a help during start up. Market finance is the main source of capital, including EPC by an ESCO where the investment of EE products are paid back by reducing energy costs. ESCOs in turn are financed by equity funds, loans from banks, special government loans etc. (Kong et al., 2012).

Many demonstration projects have been successful and are stimulating the confidence of Building property units and owners to take part of building EE. Especially in the northern part of the PRC where heating costs are high and where the owner can save a lot of money through the use of more efficient technology. (Kong et al., 2012)

4.8 National agencies and ministries in the PRC

There are several agencies, committees and ministries in the PRC. The most relevant are briefly described in this section as they are continuously mentioned in the literature and have great impact on the ESCO market.

4.8.1 ESCO committee of China energy conservation association

ESCO Committee of China Energy Conservation Association (EMCA) is an industrial association of China’s Energy Conservation Service Industry and was officially registered in
November 2003. It acts as the implementing agency of the ESCO Service Component of World Bank China Energy Conservation Project Phase II which is the 2nd phase of the World Bank’s implementation plan of ES in the PRC. The mission for EMCA is to promote a sustainable development of the ESCO industry and to support fast and healthy growth of ESCOs. To do this, EMCA holds and participates in a range of activities such as training, technical assistance, promoting and international co-operation. The responsibilities of EMCA are as follows: (EMCA, 2009)

- Promote and disseminate EPC Mechanism in China, and develop energy conservation service industry
- Work closely with government to disseminate policy and regulation regarding energy conservation
- Conduct trainings and marketing activities, enhance communication and co-operation
- Set up EMCA information platform and display new features of ESCO industry development
- Conduct policy study and build up friendly environment for the development of ESCO industry
- Advocate the self-discipline of the industry, and promote the healthy and sustainable development of the industry

4.8.2 National development and reform commission
The National Development and Reform Commission (NDRC) is the agency in the PRC in charge of macroeconomic management. It studies and formulates policies for social and economic development and takes part in the restructuring of the economic system. The NDRC was formed in 2003, replacing State Council Office for Restructuring the Economic System and part of the State Economic and Trade Commission. With this reorganization, the NDRC got increased responsibilities and now has a number of functions: (NDRC, 2013)

- To formulate and implement strategies for national economic and social development, long-term plans, annual plans, industrial policies and price policies
- To monitor and adjust the performance of the national economy, maintain the balance of economic aggregates and optimize major economic structures
- To examine and approve major construction projects
- To guide and promote economic system restructuring
- To carry out strategic readjustment and upgrading of industrial structure, coordinate the development of agriculture and rural economy and guide the development of industry
- To formulate plans for the development of the energy sector and manage national oil reserve
- To promote the sustainable development strategy, social development and coordinated development of regional economy and implement the Western Region Development Program
- To submit the plan for national economic and social development to the National People’s Congress on behalf of the State Council in accordance with the Constitution
4.8.3 Ministry of housing and urban-rural development
The Ministry of Housing and Urban-Rural Development (MOHURD) is the ministry in the PRC which is responsible for the administration of construction. Main responsibilities include drawing national standards of construction, green building labeling, guiding and regulating the construction market and administrating the housing and real estate industry. (MOHURD, 2013)

4.8.4 Ministry of finance
The Ministry of Finance (MOF) is the national executive agency of the Central People’s Government which administers the national annual budget and macroeconomic policies. It is also in charge of economic regulations, government expenditure, macroeconomic data recording and fiscal policies for the state. MOF is smaller in size compared to many other countries; this is because macroeconomic management is primarily handled by the NDRC. (Ministry of Finance, 2013)

4.9 Five-Year Plans
The central government in the PRC is using FYPs to map strategies for economic development, set target and launch reforms. The first FYP in the PRC was established in 1953 by Mao Zedong, four years after the establishment of the PRC. Except for 1963-1965, the FYPs have been continuous. It was based on the Soviet approach based on state ownership and centralized economic planning. (Kong et al., 2011)

Since the founding of PRC, the central government has released twelve FYPs where the last one, the twelfth, was released on March 14, 2011. The content and targets of each plan are changed significantly due to the economic growth and development. Each plan has a either a separate chapter or section containing information related to the national energy policy, which in recent years has become more specific and important. (Yuan & Zuo, 2011)

By analyzing all of the twelve FYPs Yuan & Zuo (2011) observed a significant change in the PRC’s energy policies. Before 1980, the major target of the plans was to increase energy production, as well as energy usage. From the first FYP to the eleventh, the production increased more than 32 times. Since the sixth FYP there have also been efforts put on improving the EE. Since then, the reduction of carbon dioxide emissions has been an increasingly important topic, receiving more attention in each plan. At the same time, the PRC’s energy policies are getting more focused on the global issues of carbon dioxide emission and climate change. The focus of current and future energy policies of the PRC is set on increasing EE, developing more renewable energy, reducing emission of GhG and improving the capability of coping with climate change. (Yuan & Zuo, 2011)

4.9.1 The Eleventh Five-Year Plan (2006-2010)
The eleventh FYP started in 2006 and ended in 2010. One of the prime energy goals was to achieve a 20 percent energy intensity reduction. By the end of the eleventh FYP, the energy intensity had decreased by more than 19 percent, which is equal to 630 million tce of energy savings (Lo & Wang, 2013). This was achieved by implementing several rules and regulations. For example, new buildings had to be built in a more energy efficient way. Therefore, a ban on importing and applying energy inefficient building materials and techniques had been put in action. Furthermore, the use of renewable energy systems is strongly advocated. In existing
buildings, heating metering and EE retrofit has been launched in large scale, especially in the northern parts of the PRC. (Kong et al., 2011)

During the first four years of the eleventh FYP, EE investments increased by an annual growth rate of more than 200 percent. This is partly due to the finance incentives and subsidies introduced in this period: (IFC, 2012)

- Incentive funds for EE retrofit projects
- Financial subsidies for promotion of high EE products
- Central financial incentive funds for eliminating outdated and energy inefficient industrial methods
- Financial subsidies for the promotion of high-efficiency lighting products
- Special national bond funds for supporting implementation of major EE projects and demonstration projects
- Incentive funds for heat metering and EE retrofit of existing residential buildings in the PRC’s northern heating regions
- Energy-saving subsidies for office building of governmental organization and large-size commercial buildings
- Financial incentive funds for EPC projects, with accumulative funds applied in energy conservation and efficiency-improvement amounting to 101.6 billion RMB

4.9.2 The Twelfth Five-Year Plan (2011-2015)
In the twelfth FYP, the energy saving agenda continues and a majority of the energy conservation policies and programs are carried over from the eleventh to the twelfth FYP. Energy usage per ten thousand RMB of national GDP will have to reduce to 0.869 tce by the end of 2015 (IFC, 2012). If the PRC’s GDP is assumed to reach GDP 80 trillion RMB by the end of 2015, the target means that there will be a reduction of 16 percent in energy intensity compared to 2010, which is 4 percent lower compared to the eleventh FYP. The reason why the target was lowered was likely the result of bargaining between the central and local governments. Moreover, the percentage is not the same for all provinces. Rather, it is based on development and how well the region performed in the previous FYP. Well-developed provinces such as Shanghai get a higher reduction target, up to 18 percent, while other provinces get as low as 10 percent reduction target (Lo & Wang, 2013). The emission and energy conservation targets assigned to the provinces are ambitious, and are set in a time when the Chinese industry is still developing rapidly and currently accounts for more than 60 percent of the nation’s energy usage. (IFC, 2012)

Encouraging the use of EPC is one of the efforts directed towards ES mentioned in the twelfth FYP. With continuous government support through financial subsidies and implementation of tax policies, together with support policies from local governments and financial products from commercial banks, the future markets looks promising for Chinese ESCOs. By 2015, the PRC is planning to implement a mature ES system which will further expand the number of ESCOs and strengthen the capacity of existing companies. (IFC, 2012)
4.10 Political factors
In a study conducted in Hong Kong and Singapore, Chan, Qian & Lam (2009) found that government interventions, especially economic and advocatory incentives, are a significant drive for investor to take interest in EE investments. A summary of the national level regulations and laws in the PRC can be found on Table 7, Page 38.

4.10.1 Ministry level laws, rules and regulations
The central government in the PRC has in recent years implemented a number of national laws, rules and regulations to promote EE in buildings and a sustainable environment. There are also local adaptions to these where they are adapted to the local climate and situation.

It is the central government of the PRC that promotes the formulations of laws and regulations, incentive policies, assessment system, etc. The provincial governments then transfer the policies to local governments who in turn adapt and implement the policies. (Kong et al., 2011)

4.10.1.1 Laws
The first major energy legislation in the PRC was the Energy Conservation Law, which was released in 1997. It was the first step of the PRC’s long term strategy of economic development which involved energy conservation. The law was the first of its kind to regulate energy resources, improve efficiency, utilize renewable energy, and to structure the energy use (U.S. Department of Energy, 2011). In 1998, only about 4 percent of the existing 44 billion square meters of existing buildings met these national standards. (Hong, 2009)

The Renewable Energy Law was release in 2006 and has provisions for the use of renewable energy and heat pumps in buildings. The Energy Conservation Law was updated in 2007 in order to reflect new challenges in the EE field that has to do with the tremendous economic growth over the past years (U.S. Department of Energy, 2011). The new version contained special sections for building EE with articles relating to administrative structure, compliance and enforcement of building energy codes, indoor temperature control system in commercial buildings, urban power conservation management for lighting in public facilities and large-scale buildings, household heat metering system, and building materials. (SCNPC, 2007)

It is common that local municipals in the PRC make their own regulations based on national laws. These are made in the light of the actual circumstances in the region. In Shanghai, the municipal has made local regulations related to energy conservation partially based on the Energy Conservation Law to strengthen administration of construction related energy conservation, reducing construction related energy usage, and improving EE in construction. (Shanghai Government, 2010)

4.10.1.2 Rules
The PRC’s first national administrative rule focusing on solely on building EE was issued in 2008 in order to better interpret the related provisions in the Energy Conservation Law. To promote EE in buildings, the rules states that the government needs to provide economic incentive polices. The different stages in a construction process are approval, design, construction, and operation. The rule states that inspection is to be carried out in all these stages.
The rule is also applied to existing buildings and the utilization of renewable energy. (U.S. Department of Energy, 2011)

4.10.1.3 Regulations
To be able to implement the Energy Conservation Law, the Ministry of Housing and Urban-rural Development (MOHURD) issued *Regulation of Energy Conservation Management in Civil Building* in 2000. With the regulation, EE management is required to cover the whole process of constructing a building. (U.S. Department of Energy, 2011)

4.10.1.4 Incentives and policies
*China Medium and Long Term Energy Conservation Plan* were issued in 2004 by the NDRC. Six of the ten programs in the plan concerns EE in buildings:

- Energy conservation in buildings
- Energy efficient lighting
- Energy conservation in governmental buildings and vehicles
- District heating and power generation
- Recovery of residual heat and pressure
- Building the energy conservation monitoring and technological support system

In 2007, the PRC issued a number of regulations regarding special funding support for energy efficient governmental office buildings and large-scale commercial buildings. The central government would give a discounted load to subsidize energy efficient renovation projects and these types of buildings. For local projects, the government paid 50 percent of the interest on loans and all the interest for central government projects. (U.S. Department of Energy, 2011; Kong et al, 2012)

In 2010, to speed up the implementation of EPC, the General Office of the PRC State Council forwarded the ‘*Circulation of the Opinions on Accelerating the Implementation of Energy Performance Contracting*’ to Promote the Development of the ESCO Industry. It was jointly issued by the NDRC, State of Administration of Taxation, the People’s Bank of China, and the Ministry of Finance. The policy offered supportive measure for EPC project such as favorable tax treatment and showed that the government of the PRC was striving to develop an energy-saving service market with vitality, unique features and good order. (IFC, 2012)

In December 2010, the Tax Bureau and MOF published financial incentives for new companies who can meet the ESCO criteria:

- No corporate income tax for the first three years of operation
- 50 percent reduction in corporate income tax for another three years after that
- No sales tax

National building energy policies until 2010 are summarized in Table 7:
Table 7 Implementation of major national Laws, Standards and Regulations in the PRC. Source: Zhang et al., 2011b

- **JGJ 24-86**: Specification for thermotic design of civil building  
  1984

- **JGJ 26**: Design standard for energy efficiency of civil building (heating residential buildings)  
  1986

- **GBJ 19**: Design code for heating, ventilation & air conditioning  
  1987

- **JGJ 37**: Code for design of civil buildings  
  1990

- **GBJ 133**: Standard for design of artificial lighting in civil buildings  
  1993

- **GB 50189**: Thermal design for tourism hotel  
  1999

- **GB 50176**: Thermal design norm of civil buildings  
  2000

A MoC office in charge of BEC was established  
1994

- **JGJ 26** was revised  
1995

- **Energy Conservation Law of PRC** was enacted  
1997

- **GB 50096 (2003 version)**: Design code for residential buildings  
1999

- **JGJ 129**: Technical specification for energy conservation renovation of existing heating residential building  
2000

- **JGJ 134**: Design standard for energy efficiency of residential buildings in hot summer and cold winter zone  
2001

- **JGJ 75**: Design standard for energy efficiency of residential buildings in hot summer and warm winter zone  
2003

- **GB 50019**: Code for design of heating ventilation and air conditioning  
2004

- **GB 50034**: Standard for lighting design of buildings  
2005

- **Renewable Energy Law of PRC**, Regulation of Civil Building Energy Saving (MoC) were enacted  
2006

- **GB 50352**: Code for design of civil buildings  

- **GB 50189**: Design standard for energy efficiency of public buildings  

- **GB 50386**: Residential building code  

- **DB-153**: Design standard for energy efficiency of public buildings  

- **GB/T 50378**: Evaluation standard for green building  

- **JGJ 67**: Design code for office building  

**Energy Conservation Law of PRC** was revised; Medium and Long-Term Development Plan for Renewable Energy in China, Green Building Evaluation Technology Rules (Probation) and Management Regulation of Green Building Label were announced  
2007

- **DB 29-1**: Tianjin residential energy-saving design standard  
2008

- **China-Green Building Council (China-GBC)** was established  

- **Ordinance on Civil-building Energy Conservation** was announced  

- **Green Building Label Management Office under MoC** was established  

**Renewable Energy Law of PRC** was revised  
2009

The 2nd Annual Asia Eco Green Building Congress in Shanghai  
2010
4.10.2 Shanghai

Shanghai is one of few Chinese cities to issue building design standards before 2005 when many of the national standards came into effect, see Table 7. The ‘Shanghai Public Buildings Energy Efficiency Design Standards’ were issued in 2003, almost two years before the national standards. They were tailored for the climate and conditions in Shanghai and encompassed all aspects relating to energy performance of new and refurbished commercial buildings. The standards were not enforced and mostly used as a reference for commercial buildings. (Kung, 2011)

When the national standards were released in 2005, the Shanghai municipal government developed new measures, called ‘Shanghai Energy Efficiency Building Design Standards’ which were issued in mid-2005. The standard encourages the use of energy efficient materials and adopts energy saving technologies for ventilation, heating, cooling and lightning in commercial buildings (Jiang, 2011). In 2008, Shanghai launched its own marketplace for environmentally-related financial products, aiming to become a forum for stakeholders in GhG reduction projects. The exchange also initiated domestic trading related to emission trading known as Pollution Discharge Rights, targeting the building sector. (Kung, 2011)

4.10.3 Stakeholders

There are several stakeholders involved in the commercial building energy governance in Shanghai. This section helps to give a brief overview on the collaboration between actors which is visualized in Figure 14.

Shanghai has to adopt macro-policies set by the central government as they are under the central government’s rule. The Shanghai municipal government has restricted authority in its jurisdiction’s affairs. They do however have independent rule with respect to economic development, urban planning, infrastructure, civic facilities and budget. They also work with ESCOs on retrofit and demonstration projects. (Kung, 2011)

As mentioned previously on page 34, the MOHURD has the major authority for the administration of the PRC’s buildings energy usage and efficiency. The Shanghai municipal government and the ‘Shanghai Municipal Urban and Rural Construction and Transportation Commission’ (URCTC) needs to follow MOHURD’s regulations and policies. District/County Construction Bureau and Township Construction Manager need to follow URCTC’s direction. The URCTC is an important authority in the Shanghai building energy administration as they are high up in the hierarchy, right after MOHURD. (Kung, 2011)
4.11 Green building standards
In the United States, buildings annually consume more than 30 percent of the total energy and more than 60 percent of the electricity. The building design, construction, and operations therefore have a huge impact on the environment, not only in the U.S., but all over the world. Creating standards and utilizing grading systems is a way to encourage actors on the building market to reduce their environmental impact. Several different standards exist. The two most influential international standards are LEED and BREEAM, and in the PRC the national Three Star System. (USGBC, 2009)

A study conducted in Taiwan by Chang & Chou (2010) shows that green buildings are negatively associated with increased building costs. However, it is also associated with investment benefits. In particular on marketability where it was shown that promoting green buildings increases the competitiveness on the market.

4.11.1 LEED
In 1993, after the formation of the U.S. Green Building Council (USGBC), members of the organization quickly came to the conclusion that there was a need for a system to define the measure green building. Research began and less than a year after formation a committee focusing on measuring standards for green building was established. The pilot version of Leadership in Energy and Environmental Design (LEED) program, LEED version 1.0, was launched in August 1998. A modified version, LEED version 2.0, was released in March 2000,
followed by version 2.1 in 2001 and 2.2 in 2005. LEED continued to evolve and has undertaken many new initiatives, including systems for building design and construction as well as building operations and maintenance. As the green building field is continuously growing and changing, so does LEED. (USGBC, 2009)

The LEED rating system is divided into five environmental categories: Sustainable Site, Water Efficiency, Energy and Atmosphere, Materials and Resource, and Indoors Environmental Quality. It is a market driven system and it is voluntary for its users. Based on existing technology, LEED evaluate environmental performance from a broad perspective over the life cycle of the building. LEED is providing a definitive standard for what constitutes a green building in operation, construction, and design. (USGBC, 2009)

Buildings are measured on a 0 to 100 grade scale where the points are distributed over the five different categories. They are given a certificate according to scale in Table 8.

Table 8 LEED certification scale. Source: USGBC, 2009

<table>
<thead>
<tr>
<th>Standard</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certified</td>
<td>40-49 points</td>
</tr>
<tr>
<td>Silver</td>
<td>50-59 points</td>
</tr>
<tr>
<td>Gold</td>
<td>60-79 points</td>
</tr>
<tr>
<td>Platinum</td>
<td>80 points and above</td>
</tr>
</tbody>
</table>

4.11.2 BREEAM
The Building Research Establishment Environmental Assessment Method for buildings (BREEAM) was established in 1990 in the UK by the Building Research Establishment. It is a voluntary measurement rating for green buildings and has grown to be the leading standard in Europe, much like LEED is in North America. BREEAM can be used to assess any type of build anywhere in the world and standard schemes have been developed for the most popular building types (BREEAM, 2013). These can be used during retrofit of existing buildings as well as during the project phase for new buildings. Performance is measured based on a number of criteria. There is a minimum level that has to be achieved for the project process, the building’s use of energy, indoor climate such as ventilation and lighting, water usage, garbage disposal, and effect on the local environment. BREEAM also evaluates and gives points depending on how well the building is connected to public transportation, choice of building material and what pollution the building might emit. Extra points may also be giving for special innovative solutions. (SGBC, 2011)

The BREEAM rating system confirms the buildings performance against the standard on a scale from Unclassified, Pass, Good, Very Good, Excellent, and Outstanding. The Outstanding rating is the highest achievable rating given only to exemplary green buildings that score at least 85 percent on the BREEM-scale. It is hard to compare the different evaluation methods but it has been shown that the highest score in LEED is equal to the Very Good grade of BREEAM. (SGBC, 2011)
4.11.3 The PRC’s Green Buildings Label (Three Star System)

Green buildings in the PRC are recognized by the Green Building Labels (GBL) which is issued and managed by the government and technically supported by the Evaluation Standard for Green Buildings (ESGB). The governmental department in charge is MOHURD. There are about 30 local authorities, including Shanghai, that are carrying on local GBL evaluations. GBL is using three different star levels, one-star, two-star and three-star where the last one is the top level. In local evaluation, only one-star and two-star is used because the National China Institute for Building Sciences is the only agency authorized to grant Three-Star status to buildings. (Ye et al, 2013)

Evaluation can be done on both the design stage and operation stage in buildings. The system also has two different standards, one for residential buildings and one for non-residential (public) buildings. GBL evaluates buildings with different prerequisites divided into six sections and a subsection of preferred items, see Table 9. Preferred items contain policies that are harder to implement, such as more than 10 percent on-site renewable power generation and brownfield redevelopment. Stars are given depending on how many items in each section that are reached. (Ye et al, 2013)

<table>
<thead>
<tr>
<th>General items (40 Items)</th>
<th>Total</th>
<th>★</th>
<th>★★</th>
<th>★★★</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Use and Outdoor Environment</td>
<td>6</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Energy Efficiency and Utilization</td>
<td>10</td>
<td>4</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Water Efficiency and Utilization</td>
<td>6</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Materials Saving and Utilization</td>
<td>8</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Indoor Environment Quality</td>
<td>6</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Operation management</td>
<td>7</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Preferred Items</td>
<td>14</td>
<td>N/A</td>
<td>6</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 9 Building (Public) grade criteria for the Three star system in the PRC. Source: Ye et al., 2013

There were 353 Three star system certified buildings in the PRC by the end of 2011 and the number of projects is steadily increasing, but is still low compared to other assessment standards such as LEED and BREEAM. This may be due to their similarity, especially with LEED as they have similar categories and building rating system (Ye et al, 2013). With the release of the twelfth FYP in 2011, MOHURD started to subsidize new Three-Star-certified buildings at a rate of 75 RMB per square meter. This is one of the major incentives for building certifications and its purpose is to get the construction of Three-Star-certified buildings more popular. (Li & Currie, 2011)

4.12 Real estate pricing in the PRC

Some researchers believe that there is no housing prices bubble in the PRC, while others do. What can be said for certain is that the property price in the PRC is rapidly rising. From 2003 to 2007 the increase reached an average of 14 percent per year and even more in some large cities. This is a major concern for policymakers in the PRC. If there is a bubble, and it bursts, it would have severe consequences for the PRC's economy. Ren, Xion & Yuan (2012) comes
to the conclusion that the housing returns in Chinese cities do not satisfy the needed condition for the existence of a bubble.

Ren et al. (2012) also found two other interesting results. The local fundamentals, e.g. GDP growth rate, population growth, and unemployment cannot affect the local expected returns of houses. This is due to the free flow of money from the rich regions to the poor. Also, real deposit rates significantly negatively affect expected house returns.

Xie, Yu & Wu (2011) identifies two major problems with the Chinese real estate market. The main problem is the rapidly rising housing prices. The price per m² is extremely high in relation to disposable income compared to western countries. Xie et al. (2011) also conclude that the land transfer mechanism is another major difficulty. The central government is controlling the land supply in the PRC, and as of now, the demand is much higher compared to the supply which leads to fierce competition among those who want land. With no land to build on, real estate price increase even more.

Hot money is the flow of speculative capital from one country to another in order to earn short-term profit. Guo & Huang (2010) identifies that the speculative capital has driven property prices up. It has also lead to accelerating volatilities in the real estate market due to the enormous size and short-term characteristic of investing. Compared to Ren et al. (2012), Guo & Huang (2010) pinpoints a crucial problem on the market. The real estate bubble could burst due to less hot money. This would lead to devastating consequences which are capable of destabilizing the whole financial market.

Figure 15 displays how the real estate leasing and land exchange price have risen in Shanghai compared to the levels in year 2000. In 10 years, the price of land exchange has more than doubled and the leasing price has increased with about 35 percent. These numbers confirms what has been stated before; that the real estate prices are steadily increasing, no matter if it is due to a bubble or not. (SONBSS, 2011)
4.13 Barriers for energy service companies
The concept of ESCOs is attractive in a theoretical perspective. However, there are barriers to overcome to implement ESCOs in reality which depend on a number of factors such as country and sector (Ürge-Vorsatz et al, 2007). In this chapter, a number of barriers are listed that hinder the development of the ESCOs in the PRC.

4.13.1 Global barriers
The Global Energy Efficiency Indicator Survey by IBE (2012) compared the barriers for EE in a global perspective. The IBE survey identified five barriers, see Figure 16:

1. Lack of awareness of opportunities for energy savings
2. Lack of technical expertise to design and complete projects
3. Lack of certainty that promised savings will be achieved
4. Inability of projects to meet the organization’s financial payback criteria
5. Lack of available capital for investment in projects

![Figure 16 Barriers for EE projects in a global perspective. Source: IBE, 2012](image)

In Figure 17, it is evident that technical expertise is one of the main barriers for EE while awareness or available capital is not. Financial criteria and certainty of savings is about average level. (IBE, 2012)

![Figure 17 Barriers to EE by region. Source: IBE, 2012](image)

4.13.2 Barriers in the PRC
Existing research have found three main categories of barriers including: market, financial and institutional barriers. There are also two sub categories which are technology and educational
barriers where the first is mentioned in this chapter (Painuly et al, 2003; Vine, 2005; Ürge-Vorsatz et al, 2007). The main barriers are summarized in Table 10, page 48.

4.13.2.1 Market barriers
Poor energy pricing policies and lack of government support, as well as unfamiliarity with the concepts and technologies are examples of market barriers. (Painuly et al, 2003)

Low awareness and the lack of information is an obstacle for success among ESCOs in the PRC. The industry in the PRC is still in an emerging state and a large number of potential clients, financial institutions and departments are unaware of the available EE solutions (Da-li, 2009). There is also a lack of marketing and other exposures of EE projects which correspondingly contributes to the low awareness. (Wang, 2008)

The majority of the Chinese ESCOs are small or medium scale enterprises and they cannot provide quality services due to poor competence or lack of technology. It is therefore hard to convince potential clients of the benefits of the services and projects offered by small and medium scale ESCOs are usually viewed with skepticism. (Yang, Zhao & Wang, 2004)

There is no clear definition of an ESCO product from the customer’s perspective. Hence, it is hard to evaluate the quality of the product. There is also a lack of credible information and it is hard to find the right service. These problems are sources of distrust, which according to Kostka & Shin (2013) will lead to a market disequilibrium and market failure. The public ESCOs therefore have a large advantage as they invoke trust and reassure the quality of their services.

Trust related issues

Trust is a big issue for ESCOs in the PRC (Vine, 2005). ESCO products often come along with high risk and uncertainty. Trust is therefore essential in the relation between ESCO and their clients. With the ESCO industry being relative new in the PRC and most of the companies being less than two years old, there is still a lack of understanding of the ESCO business and potential. (Kostka & Shin, 2013)

Companies in the PRC, especially in the industry sector, do not trust outside companies like ESCOs. This is particularly the case when larger modification of the production line has to be made which can impose a great risk to the company’s business. Due to this, only larger ESCOs with good reputation can gain the trust of the client. (Kostka & Shin, 2013)

In western markets, ESCOs utilize niches in the market through for example provision of customized services, as in EPC. However, for this to function there is a need of trust and it has been observed that many customers in the PRC distrust ESCO activities (Da-Li, 2009). According to Kostka and Shin (2013), this may not be distrust, but rather a lack of understanding of the ESCOs and their services.

Client risk is another major problem for the ESCOs in the PRC. Clients of ESCOs sometimes break the contracts due to various reasons which may lead to a legal suit. Customers not abiding by the original contract are one of the more common issues for ESCOs in the PRC (Kostka &
Shin, 2013). A legal suit costs money and time that the small ESCOs do not have. This has forced many ESCOs to give up on their business. (Ürge-Vorsatz et al, 2007)

4.13.2.2 Institutional barriers

Weak contract and legal enforcements, unfavorable tax rules as well as high administrative obstacles are examples of institutional barriers. (Painuly et al, 2003)

There is a large potential market in the great number of government owned facilities in the PRC. However, with the current financial management, laws and policies, ESCOs have difficulties implementing EE projects in this category. Also, ESCOs cannot share the benefits of EE through EPC with the government owned facilities with the current policies (Wang, 2008). Leaders for state-owned enterprises (SOE) often serve for an average term of three to five years. Procurement of ESs means using current resources to save money for their successors. The leaders are evaluated based on the current performance of the company. Thus, large investments by public companies in ESs are unlikely. (Ürge-Vorsatz et al, 2007)

Developed countries often support implementation of EE services by favorable taxes or other regulations which helps the ESCOs to succeed on the market (Vine, 2005). There are no standardized audit procedures to conduct before implementing ESs. Thus, it is hard to evaluate the effects of EE projects and there are often disputes regarding the results (Da-Li, 2009). This partly has to do with bad communication, misunderstandings and inadequate contracts. For instance, ESCO contracts in the US are hundreds of pages while in the PRC they are typically around two pages to start with, and are later filled in as the project moves forward. (Kostka & Shin, 2013)

4.13.2.3 Financial barriers

Financial barriers consist of the inexperienced banking industry in the PRC as well as high credit risk for EE projects (Kostka & Shin, 2013). As the majority of Chinese ESCOs are small or medium scaled enterprises it is difficult for them to prosper due to these financial barriers. (Da-Li, 2009)

Most ESCOs in the PRC, except companies supported with funds from the WB, have to use their own equities to fund ongoing projects. EE projects have an average implementation period of three years which results in large initial costs and poor revenue in the short term. Without financial support, ESCOs cannot develop even though there is a high potential market. (Da-Li, 2009)

Up-front costs are seen as the biggest barrier to green buildings by developers, building owners as well as policy makers. No more than 3.5-year payback is expected on building efficiency measures. The additional cost of green buildings is usually supported by government funding for demonstration projects. Economic analyses conducted do not take into account social, environmental and operating costs which would support investing in green buildings, therefore it would seem as if green buildings is a bad investment. This will not change until better accounting methods are proposed and adopted. (IBE, 2011)
With the majority of the PRCs ESCOs being small in size and lacking sufficient funds to support large investments on their own, they need external investment to support ongoing projects. The ESCOs cannot take loans due to lack of awareness in the banking systems, moreover most of the loans are conducted on a proposed project using most of the company’s own equity as guarantee. This means that it is not possible to get a second loan until the first loan is paid back. Furthermore, many of the ESCOs in the PRC have been unable to demonstrate transparent accounting and financial systems and therefore not been able to convince investors (World Bank, 2008). Unlike conventional projects, where it is easy to estimate the value, ESCO projects are hard to value since it is hard to count the amount of energy to be saved and as a result of this, banks are careful when providing loans. (Kostka & Shin, 2013)

4.13.2.4 Technology barriers
A large numbers of ESCOs in the PRC are not specialized in a certain field of EE and lack the understanding of existing technologies. Also, they do not have qualified professionals to carry out the EE projects (Yang et al, 2004), nor do they have sufficient energy-efficiency technology that is affordable. (Vine, 2005)

It is hard for the customers to know what technology is used by the ESCOs. Under the ESCO banner, there are hundreds of dissimilar services and technologies offered which makes it hard for the consumer to evaluate. Even if the customers have a way to evaluate the services to find the suitable product, the search is costly and time consuming. (Kostka & Shin, 2013)
Table 10 ESCO barriers in the PRC with references

<table>
<thead>
<tr>
<th>Category</th>
<th>Typical barrier</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Market barriers</td>
<td>1.1 Poor energy pricing</td>
<td>(Painuly et al, 2003)</td>
</tr>
<tr>
<td></td>
<td>1.2 Low awareness and lack of information</td>
<td>(Da-li, 2009)</td>
</tr>
<tr>
<td></td>
<td>1.3 Hard to convince clients about the potential of ES</td>
<td>(Yang et al, 2004)</td>
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<td></td>
<td>1.4 Client distrust due to lack of tech. understanding</td>
<td>(Da-Li, 2009)</td>
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<td></td>
<td>1.5 Clients break their contracts</td>
<td>(Kostka &amp; Shin, 2013)</td>
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<tr>
<td>2. Institutional barriers</td>
<td>2.1 Laws regulating SOE activity and policies</td>
<td>(Wang, 2008)</td>
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<td></td>
<td>2.2 SOE employees do not have incentives to invest in ES</td>
<td>(Ürge-Vorsatz et al, 2007)</td>
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<td></td>
<td>2.3 Hard to evaluate effects of ES due to lack of standards</td>
<td>(Da-Li, 2009)</td>
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<td></td>
<td>2.4 Inadequate contract procedures</td>
<td>(Kostka &amp; Shin, 2013)</td>
</tr>
<tr>
<td>3. Financial barriers</td>
<td>3.1 Inexperienced banking industry</td>
<td>(Kostka &amp; Shin, 2013)</td>
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<td></td>
<td>3.2 Hard to value projects</td>
<td>(Kostka &amp; Shin, 2013)</td>
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<tr>
<td></td>
<td>3.3 High up-front costs</td>
<td>(IBE, 2011)</td>
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<td></td>
<td>3.4 Client has short term investment horizon</td>
<td>(IBE, 2011)</td>
</tr>
<tr>
<td>4. Technology barriers</td>
<td>4.1 ESCOs lack understanding of existing technology</td>
<td>(Yang et al, 2004)</td>
</tr>
<tr>
<td></td>
<td>4.2 Lack of affordable energy efficiency technology</td>
<td>(Vine, 2005)</td>
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<td></td>
<td>4.3 ESCOs lack qualified professionals</td>
<td>(Yang et al, 2004)</td>
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<td></td>
<td>4.4 Hard for customers to evaluate ESCO products</td>
<td>(Kostka &amp; Shin, 2013)</td>
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</table>

4.13.3 Barriers in Sweden

In the report ‘Analys av den svenska marknaden för energitjänster’ by the Swedish Energy Agency (Energimyndigheten, 2011), a number of barriers for ES in Sweden are listed which are briefly summarized in Table 11.

4.13.3.1 Market barriers

In Sweden, awareness of ES is a problem and there is a lack of understanding and information of business models similar to EPC. There are not enough marketing actions being made and some actors on the market blame SEA for only focusing on EPC, thus hindering new concepts to evolve.

There are not enough actors on the Swedish ES market. This leads to lack of diversity and competition which in the long run hurts the market.

4.13.3.2 Institutional barriers

SEA states the unclear definition of ES in Sweden as one of the main barriers. This is because many of the actors market their products with their own brands and names and many of the offered ES are very similar to each other.
Unclear accounting principles for ES exist in the Swedish market. It is not fully clear how investments in the client’s building should be accounted for.

Companies owned by the municipality in Sweden are not allowed to act outside of the municipality’s borders. This causes problems as many real estate owners own property all over the country and only want to buy ES from one actor. Also, these companies are not allowed to sell ES below the market price to the municipality due to market competiveness laws.

### 4.13.3.3 Financial barriers

The payback time is an issue in Sweden. Companies do not wish to have a longer payback period than 10 years. This is due to the increase of real estate prices. Investors in real estate do not understand why they should invest if their investment only benefit the next owner.

### 4.13.3.4 Technology barriers

In Sweden there is a lack of *buyer’s competence*, i.e. the client does not know what product is needed, and consequently ES of poor quality is bought. Also, there is a problem for ESCOs to find personnel with sufficient understanding of all elements included in the ES business such as technology, economy and entrepreneurship which is due to lack of specialized university courses.

<table>
<thead>
<tr>
<th>Category</th>
<th>Typical barrier</th>
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<tbody>
<tr>
<td>Market barriers</td>
<td>1.1 Client lack of technological understanding</td>
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<tr>
<td></td>
<td>1.2 Lack of marketing strategies</td>
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<td></td>
<td>1.3 Low number of actors</td>
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<tr>
<td>Institutional barriers</td>
<td>2.1 Laws and policies regulating SOE activity</td>
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<tr>
<td>Financial barriers</td>
<td>2.2 Unclear accounting principles for ES</td>
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<td></td>
<td>3.1 Client has short term investment horizon</td>
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<tr>
<td>Tech. barriers</td>
<td>4.1 ESCOs lack qualified professionals</td>
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<td></td>
<td>4.2 Hard for customers to evaluate ESCO products</td>
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</tbody>
</table>

*Table 11 Barriers for Swedish ESCOs. Source: Energimyndigheten, 2011*
4.14 Summary of key findings in the literature

Table 12 briefly summarizes the key findings from the literature, including the source and page number.

<table>
<thead>
<tr>
<th>Finding</th>
<th>Reference</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The PRC is divided into five climate zones for building design and</td>
<td>U.S. Department of Energy, 2011</td>
<td>19</td>
</tr>
<tr>
<td>Shanghai is situated in zone III, the HSCW-zone.</td>
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<td></td>
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<tr>
<td>The energy intensity in the PRC is high compared to more developed</td>
<td>EIA, 2013</td>
<td>20</td>
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<tr>
<td>countries, both in Asia and other parts of the world.</td>
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<tr>
<td>There is a rapid growth of the real estate sector in Shanghai and the</td>
<td>SMHSBAB, 2011</td>
<td>21</td>
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<tr>
<td>yearly growth rate is 5 percent for residential buildings and 9 percent</td>
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<td>for non-residential buildings.</td>
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<tr>
<td>There are a number of key actors involved in the real estate development</td>
<td>Kong et al., 2012; WBCSD, 2007</td>
<td>23</td>
</tr>
<tr>
<td>sector. These include developers, designers, ESCOs, contractors,</td>
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<td></td>
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<tr>
<td>suppliers, capital providers, government and third party organizations.</td>
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<tr>
<td>The number of ESCOs in the PRC has increased rapidly since the</td>
<td>EMCA, 2012</td>
<td>29</td>
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<tr>
<td>implementation of the concept in 1998, this is especially true during</td>
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<tr>
<td>the last 4 years. In 2011 there were a total of 2339 registered ESCOs</td>
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<td>at the EMCA.</td>
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<tr>
<td>There are a large number of national agencies and ministries involved</td>
<td>Kong et al., 2011</td>
<td>32</td>
</tr>
<tr>
<td>in the development of ESCOs in the PRC. These are guided by the central</td>
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<tr>
<td>government and the FYPs. EPC and ESCOs has been considered an important</td>
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<td>measure for increasing the building EE in the FYPs.</td>
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<tr>
<td>There are a large number of beneficial laws, rules and regulations for</td>
<td>Ye et al, 2013; Li &amp; Currie, 2011</td>
<td>36</td>
</tr>
<tr>
<td>ESCOs, both on a local and nationwide level.</td>
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<td>Green building standards are getting more popular. Particularly the</td>
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<td>local Three Star System which is also subject to subsidies.</td>
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<td></td>
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<tr>
<td>The real estate price in Shanghai is rapidly increasing. During the</td>
<td>SONBSS, 2011</td>
<td>42</td>
</tr>
<tr>
<td>past 10 years, the price of land exchange has more than doubled and</td>
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<td>the leasing price has increased with about 35 percent.</td>
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<tr>
<td>There are a number of barriers for ESCOs, including market barriers,</td>
<td>Painuly et al, 2003; Vine, 2005;</td>
<td>44</td>
</tr>
<tr>
<td>institutional barriers, financial barriers and technology barriers</td>
<td>Ürge-Vorsatz et al., 2007</td>
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<td>which are summarized in Table 10.</td>
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5 INTERVIEW STUDY

In this chapter, the most important findings from the interviews are presented. The main part of the interviews took place in Shanghai, PRC. However, there were also two interviews conducted in Sweden.

The findings from the interviews were used to draw conclusions in chapter 10 on page 102, where ESCO barriers and opportunities are discussed. The findings were also used together with the available literature to build an actor map (see page 71) and to formulate hypotheses which are tested in the quantitative study.

5.1 The competence circle

The concept of the ‘competence circle’ was introduced during a meeting with the project examiner Prof. Per Lundqvist. Lundqvist explained how many Swedish firms initially had a high degree of in-house competence regarding energy usage and EE. The model presented in this chapter is the researchers’ interpretation of the competence circle.

The Strong in-house competence is the first stage in the competence circle which can be seen on Figure 18 on the next page. In this stage the company is aware of their energy situation and has a strong buyer’s competence, i.e. they know what products to buy in order to improve the EE. There may be a unit, or at least a few people, within the company whose main focus is on energy related topics. These personnel know what can be improved and have the competence to buy proper equipment. If there would be a need of external help, they know whom to contact.

This in turn leads to the next main stage in the circle with Increased outsourcing dependence. Advanced areas of improvement are outsourced to experts in that particular area, where the in-house competence is not strong enough. This in turn leads to a rapid decrease of energy usage as the efficiency is rising.

It may be expensive to have personnel dedicated to EE within the company and at the same time outsource parts of this to expensive experts. An alternative that many Swedish firms chose was to outsource larger parts or all of the in-house competence to external firms. This in turn led to a Competence drop within the firm. As years passed, new technology was introduced and the companies soon found themselves to be more or less unaware of their energy situation. They had lost their buyer’s competence and therefore did not know what products to buy, which led to purchase of poor quality ES. This in turn resulted in a slowdown in EE measures and the energy usage is decreased at a lower rate.

At this point, the Swedish firms realized the need of in-house competence to be able to increase the speed of which the energy usage was reduced. They slowly started to Build in-house competence again in order to reduce their outsourcing dependence. Whether the circle is closed or not is not certain as many companies are still building their competence. It would seem as if the trend is going towards a mix of in-house competence and outsourcing.
5.2 Actor interviews in Shanghai

In the opening of every subchapter key findings for each field are summarized. There are five main categories: competence, communication, institutional, market, and financial. Each category has been assigned a letter and each finding has a combination of a letter and a number, e.g. B.1 or D.10. A summary of all key findings and who supported the findings can be found in Table 14 and Table 15 on page 77-78.

The interviews were recorded, transcribed and later analyzed with the help of NVivo. More information about this can be found in the Qualitative Methodology Chapter on page 5. In this part, the most important findings are presented together with selected quotes. Transcribed material can be found in Appendix J.

5.2.1 Competence

In this section, the importance of competence among ESCOs and other actors on the ES market in Shanghai is presented.
5.2.1.1 Client’s knowledge of ES

ESCO clients in the Shanghai market display low knowledge of a building’s energy system and its current status (Academic 1, 2, 3 & 4; ESCO 1, 4 & 5, 2013). Normally, clients are aware of neither the potential nor areas of improvement in their energy system (Academic 3, 2013). Variables that influence the energy use are also unknown for most clients (Academic 4, 2013):

“There are very rare cases when the clients are in very well energy saving conditions but more often than not they have little knowledge of the technical details and measurement which we need to help.” (ESCO 4, 2013)

The competence level among clients affects their ability to accomplish energy savings through EE measures. Especially the clients’ ability to identify the right measures for improving the EE of the property (ESCO 4 & 5, 2013). Furthermore the competence level among Shanghai clients makes it more difficult for ESCOs to convey benefit of improving the EE of client’s energy system. It happens that clients cannot comprehend the measures that the ESCO is advising and therefore result into disbelief and mistrust in the ES. (Academic 4, 2013)

“The customer may not understand this, or they only know a little bit but they do not know exactly the variables that can influence. The ESCO therefore have to explain this to the customers, but the customer will not actually believe what the ESCO tell them.” (Academic 4, 2013)

The low competence among clients results in extra work for the ESCOs. The ESCOs have to give the clients information suitable for their knowledge level (Academic 5, ESCO 2 & Architect 1, 2013). Especially developers are cautious about new technologies and equipment. Therefore, they require detailed information about materials and technologies before they would invest in them. (Architect 1, 2013)

“They would rely on experts and suppliers. There are some EXPOs and meetings where companies with certain tech can communicate with the developers. I think this is needed. The developers are very pragmatic and they need to know in detail about the technologies and material.” (Architect 1, 2013)

The competence circle, see Figure 18 on page 52, was shown to be accurate at describing the situation of ESCOs’ clients’ buyers competence in the ES market in Shanghai. The situation could be compared to that of the Swedish ES market, but in an earlier stage:

“This cycle also fits in Chinese market but there’s not yet either positive or negative feedbacks. For the time being, we are still trying to find a way out of energy consuming mode of production, that is, at the very elementary level of development.” (Academic 5, 2013)
A majority of the interviewees agreed on that the Shanghai ES market is getting more outsourcing dependent while the in-house competence is dropping:

“Shanghai is now in the process of more outsourcing than 10 years before. Before most management was in-house.” (Academic 4, 2013)

“... maybe the Chinese market is aware of the energy situation and it is increasing its outsourcing dependence.” (ESCO 2, 2013)

5.2.1.2 Lack of competence and differentiation among ESCOs

The technology offered by ESCOs in the Shanghai market have been converging, leading to many companies offering the same type of technology to clients. As explained during the interview with ESCO 4:

“It is very difficult to make a new invention. So the technology has converged that the ESCOs are offering” (ESCO 4, 2013)

However, ESCOs in the Shanghai market vary by size and the scope of their offering. Many of the ESCOs rely on one or two ES products. This is a common practice among many of the smaller ESCO companies (Academic 1, 2 & 4, 2013). Small ESCOs often originate from manufacturing companies of for example heat pumps and fans. When the government started to promote the ESCO market many of these manufacturing companies broadened their services and registered as ESCO companies. The small ESCOs often lack the capability to tend to the complete energy system in the building (Academic 4, 2013):

“Actually no. Normally, the ESCOs are very small and do not have this ability. They can only do variable frequency drive for the pumps, they are derived from a company that sold variable frequency pumps. Or some companies have some special products, they can only do this one.” (Academic 4, 2013)

ESCOs in the Shanghai market differentiate by the quality with which they conduct research of a buildings energy system and the quality of their proposal of a scheme. Furthermore, ESCOs are competing by level of their project management, construction, financing and operating services. (ESCO 1, 4 & 5, 2013)
“The government is more into packaged services instead on the services that are specified to one service. So the difference lie in the level of competence within the ESCO company, which involve the research stage and proposal of a scheme that is appropriate for the project, financing, construction, operation and management. These are the main points that differentiate the different ESCOs in the market.” (ESCO 4, 2013)

In general, the ESCO services available in Shanghai are focusing on installation of new equipment as means for improving the EE of the building. The service typically includes maintenance service of the equipment during the duration of EMC. Operation and FM services are not typically included in the ESs in Shanghai (ESCO 1, 4 & 5, 2013). The integration of technologies and new equipment is often poor and there is a need to educate the people who will operate the equipment or adapting the new technology. (Architect 1, 2013)

“We have many many new technologies but very few can play an important role in the transition for the industry. And how to integrate the tech and the usage need and the people uses. The equipment is still for people so the right people need to use it so it needs to be part of the service.” (Architect 1, 2013)

It is not unusual for a small ESCO to be unwilling to accept large or too complicated projects. Apart from the financial difficulties involved, it is rare that the smaller ESCO have the required competence to complete the project in a proper way. The ESCO is afraid of causing disruption on behalf of the clients operations, which may become a costly mistake: (Academic 5, 2013)

“When they [ESCOs] do business with large enterprises, the energy saving companies normally do little to better their service in case they would meddle up the complicated industrial procedures which they had little knowledge of. The ESCOs are not so technologically advanced so they might think twice before taking on complicated projects.” (Academic 5, 2013)

5.2.1.3 Facility management competence

Findings:
- (A.5) Poor facility management due to low technical understandings, operation and maintenance of the energy system used in buildings hamper the total EE of the property.

FM plays an important role in the maintenance and continuous development of buildings. The FM and operation of buildings in Shanghai is poor and contribute to low performance of the energy system within the buildings (Academic 1, 2, 5 & ESCO 2, 2013). Poor FM in Shanghai can partially be explained by the low level of technical knowledge among the FM personnel. (ESCO 2, 2013)

“They are in a virgin state. Now they are focusing on energy, but most facility management they just have a very low knowledge about the facility system and do not know how the pumps and fans work. They just start and close them every day and measure the in and out temperature but do not know how they function.” (ESCO 2, 2013)
This problem is also evident for ESCO operated EPC. FM and operation is often neglected, resulting in poor overall performance of the energy system. (Academic 5, 2013)

“One contracting maintenance system is usually implemented in hospitals or schools by energy-saving companies, but not in good shape.” (Academic 5, 2013)

5.2.2 Financial

Financial related findings from the interviews are presented in this section. This includes investments in ES, valuation of ES projects, contractual disagreements and financing of ES.

5.2.2.1 Investment in ES

Findings:
- (B.2) Short term investment horizon among owners limits the interest in ES
- (B.3) Focus of large EMC Contracts among ESCOs with large initial investment and long payback time > 2-3 years and minimum 3-5 years to be considered profitable, stands in conflict with the investors short term investment horizon
- (B.5) The expense of energy is relatively low compared to the total revenue of buildings

The payback time of investments is an important factor when deciding whether to invest or not in ES. Companies with a long term perspective, such as SOEs, insurance companies and certain developers are more willing to invest in ES compared to companies with short term investment perspectives. (Investor, 2013)

For offshore funds, investments must be profitable within five years and for onshore funds within three years. Investment costs for many types of ES are not offset within 5, 10 or even 15 years, meaning it is not to consider (Academic 2; ESCO 4; Investor, 2013). There would be no profit for the ESCOs if the contracts were to be shorter. The typical contract in the PRC stretches twice as long as the actual payback period. (ESCO 4, 2013)

There is a cost of money for all types of investors; if the investment can give returns above their cost of money then they will certainly invest in EE projects. Building investors usually require an internal rate of return over 15 percent (Investor, 2013). As of today EE is not interesting for short term investors were increased cash flows is the most important:

“In my study there is one building near People’s Square completed in 1997 that looks very old... The building was bought in 2006 and renovated. The rental was about 4 RMB per square meter per day when they bought the building. They only renovated the entrance, the lift lobby and the common areas and the rental jumped to 6-7 RMB within 2-3 years. They only improved the external, not the energy technology, because now it looks very high quality.” (Investor, 2013)

For owners and investors, it is easier and cheaper to increase the rent rather than decreasing the costs, especially in the central areas in Shanghai where the demand is very high (ESCO 3, 2013). Investing in energy equipment takes time and is expensive:
"It is much easier to raise the rent by minor investments in external decorations rather than investing in the equipment. It takes time, and it is expensive. For fund guys, it is not interesting to invest in energy equipment." (Investor, 2013)

Long term investment is not an option for most building owners. This is partly due to the constant change of the city plan in Shanghai. There are always new parts of the town being built, and it is impossible to predict the future. Changes in city planning may force owners to demolish their buildings, thus making long term investments risky. (Academic 3, 2013)

ESCOs tend to offer long term contracts, even though there is a demand for cheaper and short term ES:

"At least 6-8 years on average, some companies even do the contract up to 15 years." (ESCO 4, 2013)

A reason not to investing in ES in the short term is the cost of operation. The energy cost is relatively low compared to the total cost of a building.

"I think for office buildings most of the operating level expenses are around 30 % of the total revenue. The total revenue includes the rent, car parking, property management fees, utility fees etc. Within this 30 % operation expense I think around 8 % is about the energy cost." (Investor, 2013)

Clients prefer other companies, such as the ESCO, to finance the whole efficiency investment rather than paying for it on their own:

“One reason is that normally the owner doesn’t want to invest money on this and they want to use other companies to finance." (Academic 4, 2013)

“For developers, insurance companies and SOE end users are willing to pay, but for short term investors fund investors I cannot see such tendencies.” (Investor, 2013)

5.2.2.2 Valuation of ES

Findings:
- (B.1) Difficulties exist in calculating the expected value of the ES for client and ESCOs. Arising from lacking standardized methods, weather aspects, business cycles and investors valuation preferences

Valuation of ES is a problem, both for ongoing projects services that are offered. The energy saved depends on many variables, such as outdoor temperature, occupancy density, and production capacity. This makes it problematic to pinpoint what the actual saving originates from. Sometimes there is no saving due to external factors, and then it is hard to prove that the situation would actually have been worse without the ES. (Academic 4 & 5, 2013)

“Another problem is how to evaluate energy saves from different projects. This is technology, on how to exactly calculate the energy savings, methodology. For buildings, I think, is more
complex. The energy saves depends on different variables, for example the outdoor temperature and the occupancy density and other variables.” (Academic 4, 2013)

The customers may not always understand why no saving was made as they only have little or no knowledge how external factors influence the final result. This in turn may lead to conflicts. There are new standards issued for this type of evaluation, but there are still more needed (Academic 4; ESCO 2, 2013). Sometimes the local government issues a third party to evaluate savings made in a project. The third party may be a university where teachers and students will help to evaluate the effects of ESCO projects. This is important for the ESCOs as they will not get subsidies if they cannot prove that they have actually made EE improvements. (Academic 4, 2013)

When valuating an ES, thinking outside of the cost savings from lower energy usage can be of importance. Tenants may be willing to pay more rent for certifications and better indoor climate:

“There are two parts the total improvement turnover and also the reduced cost by installing efficient equipment. Some tenants are willing to pay more for energy efficient buildings, so it is not only the energy efficiency savings.” (Investor, 2013)

5.2.2.3 Contractual issues

Findings:
- (B.6) Contractual disagreements used to be a common occurrence in the market

When an ES is performed, there is always a contract between the participating companies. According to the interviews, there were occasionally problems with the contracts (Academic 4 & 5; ESCO 1 & 2, 2013). This may be due to the measurements in the contract not being well termed and the client may argue that the company’s reduced energy usage is due to lower productivity or other external changes like variation in climate. It is however rare that a large client with a good credit rating would start a contractual conflict (Academic 4 & 5, 2013). Problems were more common a few years ago, nowadays there are guidelines and standards to follow on how to calculate the energy saved (ESCO 2, 2013):

“Yes previously we always have such problems, because the client did not agree on the savings that the ESCO promised. But now we have the guide or standard on how to calculate this.” (ESCO 2, 2013)

5.2.2.4 Financing of ES

Findings:
- (B.7) It was, and is still to some extent, problematic for ESCOs to acquire loans
The lack of financing is still a problem for ESCOs in the PRC. It is problematic to acquire loans for smaller companies as the banks do not have sufficient information about the ESCO business. (Academic 1; ESCO 1 & 2, 2013)

“...most of the ESCO companies are small and it is therefore very difficult for them to borrow money from the bank. Only by contracting, they cannot borrow money. Even from other sources it is difficult. The reasons for this are very complex and it is not so easy to solve this problem.” (Academic 4, 2013)

“We started the ES market in 90s such as ECM but it is has not developed well in China because some difficulties in financing and some policies. And the credit, because some small ESCOs cannot get bank loans from the Bank.” (ESCO 2, 2013)

There is now a change in the business climate for ESCOs. It is easier to get loans and the government is more positive to the businesses. This enables smaller ESCOs to buy equipment of their own rather than letting their clients finance it, thus increasing the number of potential clients.

“But now since the media the government gives this business attention and the government and the banks will give this kind of business loans and they are promoting this kind of business so it is more and more popular.” (ESCO 4, 2013)

5.2.2.5 Different business types and sizes

Findings:
- (B.4) Depending on the size or business entity, developers have different purposes for ES and certifications

Local real estate companies who want to attract foreign clients would want to get international certifications as it would yield a higher profit. If they have no interest in foreign clients they would rather aim for the Three star certification. (ESCO 3, 2013)

SOEs are willing to pay more for ESs as they have a more long term perspective:

“They use it for self-use and will be in their book for a long time even extend the land use. For most offshore PE funds or RMB funds it is about 5 years plus and option to extend for one year for offshore funds. For onshore it is most likely 3 years plus one. Therefore they are looking for 5 and 3 year terms and what kind of return that the project can deliver during this time.” (Investor, 2013)
Government incentives are important in the Chinese ESCO market as the market is young and mainly consisting of smaller companies. Many ESCOs consider the government’s support and positive view towards the ES market as the main reason for them to enter the ES market in the first place (ESCO 1, 4 & 5, 2013). Without subsidies, the market would shrink to less than half its size and it would be problematic for the ESCOs to survive (ESCO 3 & 4, 2013):

“Honestly, for local investment many are just after subsidies others is because the government want them to do it.” (ESCO 3, 2013)

The absence of government support has already taken its toll in other markets, such as the solar energy market which used to be subsidized by the government:

“There was a time when the government tried to promote solar energy but the market crowded out in response most of the companies that rushed for business. In the beginning, those enterprises couldn’t survive without subsidies but in the end they went bankrupt due to it.”

(Academic 5, 2013)

The risk of policies and regulations changing over the coming couple of years are still very small. The government is still promoting this kind of business, and will continue to do so in the foreseeable future. (Academic 1; ESCO 1 & 4, 2013)

There are nationwide policies that are organized by the central government, and local policies organized by the local government. The government of Shanghai has for example issued energy quotas for hotels and office buildings (ESCO 2, 2013). However, when applying for subsidies, the companies have to go to the ministry of construction which is part of the local government. The subsidies are different depending on where in the PRC they are given, in Shanghai for example, they are relatively high and most of them are a direct type of subsidy (Academic 5; ESCO 3, 2013). The subsidies have increased the market for different kind of ES such as EPC. (Academic 4, 2013)

When the government is evaluating projects to give subsidies, they often get help from a third party:

“...the government would issue some third party evaluation unit for example Tongji University and teachers and students join evaluation for ESCO projects. According to tables and reports from ESCO companies, we calculate and do some evaluation and we write a formal report and send it to the government. We evaluate the value of the energy saves made by the ESCO...”
Company. Is it right or not? It is according to the actual condition or not? Then government would give some money to the ESCO company according to the evaluation result.” (Academic 4, 2013)

To get subsidies, the government needs to have insights of the subsidized company and they also demand a certain level of control:

“In China, according to specific regulations, energy service companies cannot do whatever they want. They have to follow the regulations. And government officers usually get involved with energy service associations that give suggestions to the company.” (Academic 5, 2013)

The past two years, the local government has issued numerous policies to encourage the ES market and energy savings. The government has also given incentives to banks to give loans to ESCOs, thus enabling them to buy the equipment of their own and making financing easier. Without the financing, it is hard for the ESCOs to sell projects as most of the customers are reluctant to invest on their own. (ESCO 2 & 4, 2013)

There are also new and stricter energy regulations proposed by the government which will slowly force the market to become more energy efficient. Together with subsidies and financing policies, this creates many opportunities for ESCOs (Academic 1 & 5; ESCO 1, 2013). FM will also become better with tougher requirements from the government:

“Why should they do the extra job if there are no such requirements from the government? But it will get better when they get more understanding and when the government put more requirements on them.” (ESCO 3, 2013)

The governmental support has not only helped with financing issues, it has also decreased some of the trust barriers on the market and contributed to an increase of the awareness of ESs:

“Another factor that was a disadvantage before was that the clients were not so aware of this kind of business in the past so they were quite suspicious about this kind of business. But now since the media the government gives this business attention and the government and the banks will give this kind of business loans and they are promoting this kind of business so it is more and more popular.” (ESCO 4, 2013)

It is hard for ESCOs to do bigger projects in SOEs. Vital equipment belongs to the government and therefore cannot be moved or changed which makes it hard to do bigger retrofit projects in the buildings owned by the government. (ESCO 2, 2013)

5.2.4 Market
In this section, market related findings from the interviews are presented. This includes competition, priorities of clients, the electricity pricing, green building certifications, FM, lack of ES products, retrofit projects and finally the future of the ES market.
5.2.4.1 Competition among ESCOs

Findings:
- (D.1) Competition among ESCOs is strong and the market can be identified as developers or owners market

The ES market is increasing as more people become aware of the potential of energy savings and because the government supports it. However, most companies still do not realize that it is financially justified to invest in ES (Developer; ESCO 3, 2013). Despite this, competition in the ESCO market is getting increasingly fierce. With a rising number of ESCOs, the market is for the customers, i.e. the developers and owners. The customers can chose among a large amount of ESCOs which leads to tougher competition and decreased margins. (Academic 4; Developer; ESCO 4)

“Different energy service companies spread out in all kinds of energy markets. Who can give the lowest cost and give the best approach.” (ESCO 1, 2013)

In this competitive market, it may be hard for ESCOs to deliver good quality ESs in the whole field. That is one reason why many smaller companies chose to specialize in one product:

“There are also some bigger companies that try to do all. But for these companies the competition is very big. It is good for the companies to have one product for themselves.” (Academic 4, 2013)

It is more difficult for foreign companies to establish on the market because it is usually hard for them to understand the unique conditions applying to the Shanghai ES market:

“The market is really big but I think for foreigner and overseas company it is even more difficult. Because sometimes it is really difficult for them to understand the local conditions here.” (Academic 4, 2013)

5.2.4.2 Client priorities

Findings:
- (D.4, D.6) Energy is not prioritized for developers, owners or tenants. Other actions are prioritized to increase the value of the property and the rental premise. Such as location, handover condition, exterior, amenities etc.

EE is far from the highest prioritized investment in the PRC which can be seen in the big cities such as Shanghai. This applies to many of the actors, such as tenants and developers. Instead of a buildings energy performance, tenants have other interests and demands when they chose what building they are to rent.

a) Location is the absolutely most important factor when choosing what building to rent. (Developer; Investor, 2013)
b) The second most important thing is the hard factors. Such as the handover condition, the general layout of the facility, the design of the office as well as building quality. (Developer; Investor, 2013)

c) The third thing is the soft factors, such as property management or quality of tenants: The 500 fortune companies are more likely to lease in buildings with well renowned companies. With improved tenant profiles, more tenants will follow. (Investor, 2013)

The tenants’ behavior has been poor in regards to their use of energy. Because the HVAC is usually included when renting office space, the tenants do not care about turning it off (Academic 5; Developer, 2013). The owner of the building on the other hand cares more about raising the rent rather than cutting the costs, and ES is therefore not prioritized. The total operation time of AC is still very low compared to USA. (Academic 1; ESCO 3, 2013)

Even if the tenants cared about their energy use, it would have no effect on their costs as the demand in central areas is so high:

"Because the demand is so high, it would have no effect for the rental fee for the tenant. The landlord on the other hand would see decreased costs. It is the landlord who makes the money, not the tenant. Therefore, the tenant has no incitement for green buildings. “ (Developer, 2013)

Developers usually lack interest of ES, especially in the less central areas where price is more important. Normally, they only do the constructing and are not the final owners or operators of the buildings. Therefore, they do not need to care about the future energy costs of the building as these are paid by the final owners, who have other priorities. Developers therefore tend to aim for the minimum standard unless something else is required. (Architect 2, 2013)

"Consider something even more important: the developers who build are often not the final owners or the operators absorbing the energy cost. In other words, the energy cost is not the problem of developer... so why would he spend more money on extra insulation etc? “ (Architect 2, 2013)

5.2.4.3 Electricity pricing

Findings:
- (D.2) Low margins among Chinese companies are pushing back stricter building regulations from the government that could have encouraged more EE measures in buildings
- (D.12) Relatively low electricity price

The Chinese electricity market is state owned. The current low electricity price is an important factor behind the success of the Chinese industry. However, it also leads to higher energy usage and less demand for ES as the potential costs saves is lower (Academic 1 & 2; ESCO 4; Architect 2, 2013):
“The first thing is the energy price. PRC the government is strictly controlling the electricity price. If it is rising maybe everything may be rising. So they are seriously controlling the electricity price.” (Academic 1, 2013)

“Also the price of the energy in China is comparatively low compared to abroad so the profit from this service is lower than it could have been.” (ESCO 4, 2013)

“... combine that with the fact that energy is still relatively cheap and you have a rough answer as to why no one is jumping on this [ES] opportunity.” (Architect 2, 2013)

A rise of the energy price could cause chaos in the market. The uncertainty of the future would increase leading to a decrease of investments. (Academic 3, 2013)

The government is working on a way to establish energy usage benchmarking tools for different buildings types. Currently, data is gathered for different types of buildings which will lead to changes in the future, especially for commercial buildings. If the buildings are consuming more than the set limits, the owners will have to pay a much higher price for electricity. (ESCO 3)

Raising the energy costs or taxes or in others ways manipulating the market to use more energy efficient solutions is not without problems. The Chinese industry is having problems with increasing costs, which in turn leads to lower margins. As the margins are low, there is no room for extra investments. If the government would implement tougher rules and regulations, it would severely affect the industry in a bad way and many would lose their jobs. Service companies on the other hand have higher margins and are more willing to invest in expensive buildings. (Investor, 2013)

“You can see that there is a lot of pollution in the cities and every one cares about that because it affects the health. But it is very hard to restrict the industry because many people may lose their jobs.” (Investor, 2013)

5.2.4.4 Green building certifications

Findings:
- (D.13, D.14) For green building certifications two drivers exist in the current market. The subsidies from the government and the niche demand of green buildings by companies with a green profile, often foreign companies

Green building certifications is something fairly new in the PRC but growing rapidly. The number of buildings with the local Three star certification has doubled in Shanghai the last year. There are mainly two drivers for the construction of GBL buildings. One is companies with green profiles with enough money to invest in the more expensive green buildings. This in turn drives more local developers to construct the certified buildings. The other driver is government subsidies which are given for the Three star certification but not for LEED or other international labels. There are both local and national subsidies which can cover all or large parts of the extra cost of GBL. (ESCO 3, 2013)
Foreign companies usually want international certifications such as LEED, while local companies prefer the Chinese Three star system (ESCO 3; Developer, 2013). It is much more common that foreign companies ask for green labeled buildings compared to local companies. However, it is getting more important for local companies to have a green profile which may lead to an increased demand in the future. (Developer, 2013)

When constructing GBL buildings, the cost is about 30 percent higher compared to a normal building (Architect 1, 2013). Some companies aim to get two certifications, as that would bring double benefits:

“For us, we want to advise double certifications for a project. If we get star certification we get subsidies and if we get LEED we increase the value of the building.” (ESCO 3, 2013)

It is however not always beneficial in neither a cost nor an energy point of view to construct buildings using the international certificates such as LEED:

“Theoretically, the green building label would reduce the cost of energy used. In the United States it does to about 30 percent. But our experience in China is a little different because we use different kind of system than the US. People here the time we use the HVAC is much lower than in the USA. Even we have a LEED building here then it would even use more energy here than a normal project.” (ESCO 3, 2013)

The reason for the usage of international standards is, as previously mentioned, the demand from foreign companies due to policies.

5.2.4.5 Facility management

Findings:
- (D.5) FM in buildings often outsourced to 3rd party with low incentives to suggest EE solutions to the owner

Poor energy performance can be caused by the lack of incentives for a third party FM company to reduce the energy usage in a building. The energy cost is paid for by the tenant. This in turn removes the drivers for the FM or the owner to invest in increased EE of the building.

“The energy cost is paid by the clients renting the office spaces so there are no drivers for the property management company to save energy. If they change the lights, they have to pay for it but they won’t get anything in return.” (ESCO 3, 2013)

Only in very few cases when the tenant is organizing the facility management in-house would the FM benefit from increasing the building’s EE.

“Both, if they [tenant] have some special outsourcing company to manage their facility system and focusing on energy system and energy measurement system to ensure the profit of the system. But I do not think this is common in Shanghai” (ESCO 2, 2013)
Today, more and more of the FM is outsourced meaning that the competence is no longer in-house, especially for residential and office buildings. It is much easier for ESCOs to work with industrial companies, where the FM often is kept in-house. In-house FM has incentives to invest in equipment that would save energy, thus lowering the costs. (Academic 4; ESCO 3; Investor, 2013)

When a third party is operating the FM they may be reluctant to cooperate with ESCOs. The FM may feel that it is their job and that they can do it themselves:

“If we go to a building, we can find 20-25 things to do in a building. If we go to the industry it is about 10-15. Every time we go to the Facility Manager no matter it is a facility or a building they do not want our help and they feel that they can do it themselves.” (ESCO 3, 2013)

5.2.4.6 Lack of ES products

As of today, many of the offered ES are too expensive for many actors. The technology or solutions offered does not need to be very advanced. Small changes can make large impact on the usage of electricity. (Architect 1, 2013)

The EE technology used in the PRC is not as modern as in Europe and USA.

“There are consultancy services in China but there is a huge gap in terms of technology between China and abroad, for example, the heat pumps, solar energy service etc.” (Academic 5, 2013)

5.2.4.7 Disruption during retrofit

The level of which retrofit ES disrupt the operation of buildings is highly important. The client may not want to perform changes in the building that can cause temporary loss of income or other disturbances. Larger retrofit projects may therefore be discarded even if they would be profitable. (Academic 4; Investor, 2013)
5.2.4.8 Future of the energy service market

Findings:
- (D.7) The potential for ES aiming for raise the EE or energy conservation is vast in the PRC
- (D.8) Urbanization, rising wages, inflation costs and electricity prices are making ES more attractive in the future

When asked about the future of the ES-market, all interviewees agreed on the potential of the market.

“The market is not bound to succeed, even though there are huge market potentials due to economic growth and urbanization in China. ... But in general, I’m very optimistic about the energy market.” (Academic 5, 2013)

“If we can solve the credit, then we will have a very big market.” (ESCO 2, 2013)

“Huge potential in the market over the next five years.” (ESCO 4, 2013)

Many of the buildings constructed during the past years have been built quickly with low EE standards. With the implementation of stricter EE regulations and with poor FM, these buildings will soon be in need of ES. (ESCO 1 & 2, 2013)

“There existed too many buildings in the market that ignored energy conservations in the past decades, which brings great potentials in the energy-saving markets since there are stricter and more standards and regulations imposed by the government now.” (ESCO 1, 2013)

Despite the great potential, there are still many obstacles to overcome. But with new technology, better credit funding, standardized regulations, government support, and better understanding of the maintenance systems, the potential over the coming years is huge. This can be understood only by looking how the ES market has grown over the last five years. (Academic 5; ESCO 1, 2 & 4, 2013)

In a near future, about four to five years, all new buildings would need to be certified with the Three star system. Currently, this system is voluntary and therefore not very popular as the cost is higher that the benefit. Making it mandatory will inevitably increase the market. (Academic 1; ESCO 1 & 3, 2013)
A problem in the ESCO market is that some clients have had bad experiences with ES in the past. Combined with the low knowledge of ES in the past, this has affected the market and led to a certain level of distrust (ESCO 3, 2013):

"Another factor that was a disadvantage before was that the clients were not so aware of this kind of business in the past so they were quite suspicious about this kind of business." (ESCO 4, 2013)

Communication is important when the ESCOs are increasing the client knowledge or looking for potential new clients. In a majority of the cases, it is the ESCOs that approach the potential clients and not the other way around. This applies to new projects as well as retrofits (Academic 5; ESCO 1 & 4, 2013). When approaching a client, it is important to have connections or they may not listen to you, connections are therefore more important in the PRC than in western countries (ESCO 4, 2013). There are also cases when the client contacts the ESCO directly. This happens when the client knows about the potential cost saving ESs might have and knows about the services offered by the ESCO (Academic 4 & 5, 2013):

"The energy service company would approach their clients first most of the time and offer basic information. But there are also other times when the clients know very well about the whole procedure in a certain industry, they would contact the company directly." (Academic 5, 2013)

Failing to communicate with clients is a great problem since the ESCOs will not get any projects and this would eventually terminate the business. Most people do not know about ES and the potential of it. More communication is therefore one of the things that most ESCOs can improve (Academic 3; Architect 1, 2013). One way to reach out the potential clients is by doing surveys and research and then offer suggestions of improvements and budget reports free of charge. This will often lead to further business (ESCO 1 & 4, 2013):

"No, people in general do not know about energy service and the potential of it. Single households do definitely not know about it." (Academic 3, 2013)

"We surveyed and researched our clients and offer suggestions and reports free of charge. And they would probably contact us. After that we get into long term business relationships with them." (ESCO 1, 2013)
A problem with reaching out to your clients is that they may not believe that the ESCO can deliver what they promise (Academic 4, 2013). The same thing applies to banks as their priorities are security, and that their investment is worth their money (Academic 4, 2013). A better way to communicate the offer to potential clients is therefore to have examples of what has been done in the past, such as pilot projects or a good track record. This way, clients and banks can easily see the potential of the services as well as get an estimated budget (Academic 4, 5; Architect 1 & 2; Investor, 2013). Many of the interviewees pointed out that having a good track record may be one of the most important factors of success, the ESCOs on the other hand did not mention this:

“No one likes to be first, especially when there are unknowns. It is always safer just to stick with what you know. The energy savings make sense on paper, but there are not enough real life case studies to validate what has been calculated on paper. Combine that with the fact that energy is still relatively cheap and you have a rough answer as to why no one is jumping on this opportunity.” (Architect 2, 2013)

“... most certainly do they need to show a track record of what they have previously achieved. It really depends on how much the owners can save on the project especially for the developers. Normally the owners would compare between different companies propose, what they charge, the track record and performance etc. If a company with a strong track record that can prove that they can save cost for the owners, I think most owners would try it.” (Investor, 2013)

It would seem as an easy task to do a pre-study of a building, gathering the necessary data and then offer suggestions of improvements to the potential clients. In reality however, it is not without difficulties. Many of the companies are not willing to share information about their building data, especially not government and industrial buildings. Some of the industrial building owners don't want to have energy audits even though they are subsidized and the companies are paid for doing it (ESCO 3, 2013). This issue is expressed by the ESCOs:

“They just don’t know why they should share the data with you. I think for normal buildings it is easier, but for industrial buildings it is hard. They are very concerned of their data and don’t want to share it.” (ESCO 3, 2013)

It may also be a culturally related problem where the principal of energy audit or to find energy improvement areas, has a negative meaning:

“In China, audit means you are to check if you can find problems. If you instead say you’re doing energy efficiency consultancy for them, they will feel comfortable.” (ESCO 3, 2013)

“For energy audit, the government will give 30 000 RMB per energy audit if you do detailed energy audit you can get up to 60 000 RMB for it. But even with this, some companies don’t want to do an audit and share their information with the government.” (ESCO 3, 2013)

It is hard to charge for auditing services when there are companies doing it for free:

“Actually it is a challenge because in China most of these are done by manufactures like York or Carrier. They can provide the consulting for free and then sell the product. Another part is done by ESCO companies that do the engineering work. The clients often wonder why they have to pay for the energy consulting when for example Carrier can do it for free.” (ESCO 3, 2013)
5.3 Energy co-operation

Energy co-operation (Swedish: Energisamarbete) is a service offered by ÅF that differs from EPC. The main purpose of the service is to reduce energy cost and improve the indoor climate by doing small changes. 20 percent of the savings are guaranteed directly to the client, while the other 80 percent is taken by the ESCO to finance the investments. (Ahlström, 2013)

What mainly differs from EPC is that the energy co-operation service does not guarantee any output. The timespan is also more flexible and there is no need for 10 year contracts as in EPC. When offering a service like this, trust between both parts is essential. (Ahlström, 2013)
6 QUALITATIVE STUDY RESULT

The outcome of the qualitative study is summarized in this chapter. First an actor map is presented based on the findings from the interview and literature study. Secondly the result from the expert panel is shown. Finally the main points from the interview study and expert panel are summarized in Table 14 and Table 15.

6.1 Actors Map
Two actor maps, see Figure 19 and Figure 20, have been drawn based on the actor map from the literature study, see Figure 9 page 24, and the information gathered from the interviews. The two actor maps were divided into retrofit projects and new constructions. The rationale being that new constructions and retrofit projects employ ES for widely different purposes. The design of the actor maps were confirmed by the expert panel at a significance level of $\alpha = 0.05$.

6.1.1 New construction
New constructions each year constitutes a significant part of the Shanghai building stock. In the end of 2011, 9 percent of the non-residential area was new constructions made the same year (SMHSBAB, 2011). The actors involved in new constructions are mainly the same as in retrofit projects but the type of ES demanded during a new construction is typically different due to stricter building regulations and codes for new buildings. (ESCO 1, 2013)

6.1.1.1 Funding
During the funding phase the developer has the ability to seek funding from several sources. Typically the developer can receive funding from investors or banks, but it is also possible for the developer to directly fund its own projects, thus investors and banks are optional, see Figure 19. Often the investors would have different investment horizon depending if they are an SEO, offshore fund or onshore fund. (Investor, 2013)

6.1.1.2 Purchase
The purchase phase, see Figure 19, requires the close collaboration between the developer and several Shanghai administrations, see chapter 4.10.3.

6.1.1.3 Design
During the design phase several actors typically assist and regulate the developer’s design of the building such as architects as well as local regulations and building codes. For new constructions, the building codes and regulations lead to relatively better EE in new buildings compared to old buildings (ESCO 1, 2013). In turn, ESCOs may assist the architects with complicated designs and incorporating EE in the design (ESCO 2, 2013). However both the architect and ESCO services may be drawn from the developer’s in house competence, consequently ESCOs and Architects are optional for the developer in the Design phase, see Figure 19.

6.1.1.4 Construction
In the Construction phase, see Figure 19, the developer typically work with an optional contractor unless using in house competence. Furthermore the assistance of an ESCO can be
needed to measure and verify that the contractor is delivering sufficient quality in the construction. At the end of the construction phase, when the building is completed, the ESCO may acquire subsidies from the local government if the project meets the relevant criteria. For the ESCO to receive subsidies for a project is however more common for retrofit projects where the ES can decrease the buildings energy usage from a previous level. If the building meets the criteria for the PRC’s Three star system, the developer may receive subsidies for the construction cost. Furthermore, using an external ESCO and contractor is only optional and can be drawn from in house resources if available. (ESCO 1, 2013)

6.1.1.5 Leasing
Leasing of the newly constructed building can be seen as the final phase of a new construction. Typically one or more tenants will accommodate the building space. At this stage the developer may end their commitment in the building when a new owner purchases the building. It is even possible for them to end up as the final tenant of the building. Using the real estate agent (REA) to connect the developer to a potential owner and the building to tenant becomes optional. FM is another actor which is responsible for the day to day operation of the building. The FM is important for the performance of the buildings energy system.

6.1.2 Retrofit
Many ESCOs see a large potential in improving the EE in existing buildings primarily due to the large building stock of existing buildings in Shanghai with poor EE (ESCO 1, 3, 4 & 5, 2013). Therefore many ESCOs are involved in retrofit projects and incorporate ES for example in an EPC contract, see chapter 4.7.2 on page 27.

6.1.2.1 Funding
During the funding phase the developer has the ability to seek funding from several sources. Similar to a new construction project the owner can receive funding from investors, banks of for the owner to directly fund the project, but also from the ESCO especially for an EPC project (Investor; Academic 1; ESCO 5, 2013). Investors, banks and ESCOs are optional ways of funding, see Figure 20.
6.1.2.2 Re-design

The re-design phase in a retrofit project involves several actors with a similar role as in a new construction project. Most often an architect would be involved as well as local regulations and building codes that have to be followed for the retrofit project. However, building codes and regulations for a retrofit project differ from a new construction project. The ESCO may also be involved and work with the architects when implementing EE designs in the building (ESCO 2, 2013). Both the architect and ESCO services may be drawn from the owner’s in house competence, consequently ESCOs and architects are optional for the developer in the design phase, see Figure 20.

6.1.2.3 Construction

In the Construction phase for a retrofit project, see Figure 20, the owner typically work with an optional contractor unless using in house competence or if the ESCO include the services provided by a contractor. The ESCO can also measure and verify that the contractor is delivering sufficient quality in the construction. At the end of the construction phase, when the building is completed, the ESCO may acquire subsidies from the local government if the project meets the relevant criteria. Using an external ESCO and contractor is only optional and can be drawn from in-house resources if available. (ESCO 1, 2013)

6.1.2.4 Leasing

Leasing of a retrofitted building can be seen as the final phase. Typically one or more tenants will accommodate the building space. At this stage the owner may end their commitment in the building and a new owner purchases the building. In contrary to Kong et al. (2012) who suggest that the owners of the building are the end users, the interview study suggest that other tenant tend to be the end user of the building. The real estate agent act as an intermediary, finding end-users, tenants, willing to lease the building space. Since the owner of the building also may occupy the building the use of a REA becomes optional. FM is another actor which is responsible for the day to day operation of the building. The FM is important for the performance of the buildings Energy System.
6.2 Expert panel outcome

In order to continue with a qualitative analysis, the main findings were subject to an expert panel based on their operationalized version as a measure to evaluate the validity and importance. Two separate analyses were conducted, $CVR_1$ and $CVR_2$. The $CVR_1$ analysis was subject to a stricter criterion judging a statement whether or not it had an essential impact on the ES market in Shanghai. The $CVR_2$ analysis judged a statement whether or not it had an essential or important impact on the ES market in Shanghai. Results of $CVR_1$ and $CVR_2$ are presented in Table 13. $CVR_{1i}$ and $CVR_{2i}$ values are shown. Values meeting a critical $CVR$ value, see chapter 3.3, are highlighted in green. Support in $CVR_1$ analysis was found for:

- The need of FM to have technical understanding, capability of maintenance and operation of the Energy System in a building
- The importance of ESCOs to be able to show profitable past projects to clients
- The need for actors within the ES market to have knowledge of governmental policies directed towards the ES market
- The need for the operating expenses for energy compared to the total revenue from the building to be relatively high
- The need for ESCO to have a high degree of financial capability

When subjected to the less strict $CVR_2$ analysis support was found for all statements, see Table 13, except for:

- The need of financial Incentives for the Tenant to demand Energy Efficient Buildings
- The importance of In-House FM operated by the Owners
- Inflation Costs as a driver for demand of future ESs

All results were found to be significant at a $p < 0.05$ (one-tailed).
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<tr>
<th>Expert Panel Result</th>
<th>CVR1i</th>
<th>CVR2i</th>
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<tbody>
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<td><strong>Competence and technical understanding</strong></td>
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<td>1.1 The ability of Energy Service Companies to show profitable Pilot Projects or</td>
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</tr>
<tr>
<td>2.1 Financial Incentives for the Tenant is... for their Demand of Energy Efficient</td>
<td>-1.00</td>
<td>-0.33</td>
</tr>
<tr>
<td>Buildings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2 Being able to Access Client Building Data for the Energy Service Company is...</td>
<td>0.33</td>
<td>1.00</td>
</tr>
<tr>
<td>2.3 The Energy Service Companies ability to offer Short Payback Time to their</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Clients is...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.4 The Facility Management’s Technical Understanding, Operation and Maintenance</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>of the Energy System in Buildings are...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5 In-House Facility Management operated by the Owners is...</td>
<td>-0.33</td>
<td>0.33</td>
</tr>
<tr>
<td>2.6 Prioritizing Energy Efficiency by Owners and Developers is…</td>
<td>-0.67</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Institutional</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 During an Energy Service project it is... for the Energy Service Company to</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>have adequate Legal and Financial Securities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2 Relatively high Operating Expenses for Energy compared to the Total Revenue</td>
<td>0.67</td>
<td>1.00</td>
</tr>
<tr>
<td>Generated from the Building is...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.3 For Energy Services in the Future, Urbanization is an... driver</td>
<td>-0.60</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Market</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1 For Energy Services in the Future, Rising Wages is an... driver</td>
<td>-0.60</td>
<td>0.60</td>
</tr>
<tr>
<td>4.2 For Energy Services in the Future, Inflation Costs is an... driver</td>
<td>-1.00</td>
<td>-0.20</td>
</tr>
<tr>
<td>4.3 For Energy Services in the Future, Electricity Prices is an... driver</td>
<td>0.00</td>
<td>0.67</td>
</tr>
<tr>
<td>4.4 Existence of Standardized Contracts for Energy Services is...</td>
<td>-0.33</td>
<td>0.67</td>
</tr>
<tr>
<td>4.5 Having a high degree of Financial Capability in an Energy Service Company is...</td>
<td>0.67</td>
<td>0.67</td>
</tr>
</tbody>
</table>
6.3 Interview outcome
The outcome of the interview study including the result from the expert panel is represented in Table 14 and Table 15. A highlighted dark green main point indicated that it is view as Essential for the ES market in Shanghai by the expert panel (significant at CVR1i). A highlighted light green main point indicated that it is view as Important for the ES market in Shanghai by the expert panel (significant at CVR2i). Furthermore, the distribution of interviewee who mentioned a main point is indicated with an X. Red text denotes opposing outcomes or opinions.
<table>
<thead>
<tr>
<th>Main Points from Interview</th>
<th>Academic</th>
<th>Architect</th>
<th>Developer</th>
<th>Energy Service Company</th>
<th>Investor</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Competence and technical understanding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.1 Low technical knowledge among clients</td>
<td>x x x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.2 Difficulty for clients to identify measures for EE</td>
<td>x x x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.3 Low technology differentiation among ESCOs</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.4 ESCOs mainly differentiate by levels of competence</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>A.5 FM has low understanding of new technologies, maintenance and operation</td>
<td>x x x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.6 ESCOs involvement in projects focus on installation and maintenance, seldom operation and management</td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.7 Few ESCOs are able to acknowledge for the complete energy system in Buildings</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.8 Most ESCOs are limited to offering one or two Technologies/Products</td>
<td>x x x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.9 Small ESCOs are unwilling to accept larger projects due to engineering risks and inadequate securities</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Financial</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.1 ESCOs have difficulties calculating expected value of ES for clients, due to the local climate, business cycles, lack of standardized methods and investor valuation praxis</td>
<td>x x x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.2 Short term investment horizon among owners limit the interest in ES</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.3 ESCOs often have large initial investment and long pay pack time for projects</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.4 Depending on the size or business entity the developer have different purposes behind ES</td>
<td>x x x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.5 The expense of energy is relatively low compared to the total revenue of buildings</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>B.6 Contractual disagreements used to be a common occurrence on the market</td>
<td>x x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.7 It is/was problematic for ESCOs to acquire loans</td>
<td>x x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Institutional</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.1 Governmental policies and regulations have great impact on the ES market</td>
<td>x x x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.2 Favorable policies to encourage the ES market are likely to continue</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 14: Main points from the interviews. Part one.
### D. Market

<table>
<thead>
<tr>
<th></th>
<th>Academic</th>
<th>Architect</th>
<th>Developer</th>
<th>Energy Service Company</th>
<th>Investor</th>
</tr>
</thead>
<tbody>
<tr>
<td>D.1 Competition among ESCO companies is strong</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>D.2 Low margins among companies in the PRC is holding back stricter building regulations from the government</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>D.3 How much the ES disrupt the operation of the building is highly important</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>D.4 Energy is not prioritized among developers and owners; other actions are done to raise the value of properties</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>D.5 FM is normally outsourced to a party with low incentives for increasing the energy efficiency</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>D.6 Tenants lack incentives and interest to demand Energy Efficient Buildings</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>D.7 The potential for ES is great in the PRC</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>D.8 Urbanization, Rising wages, Inflation costs and electricity price will drive the ES market in the future</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>D.9 There is a need for inexpensive ES that can be scaled easily</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>D.10 There is a lack of Products to be used in ES</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>D.11 ES not including a product are difficult to sell to</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>D.12 Relatively low electricity price</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>D.13 Two drivers exist for green building certification, subsidies from the government and niche market demand by green profile companies</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>D.14 Green building certifications is more common for foreign companies but the demand by local companies is growing</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

### E. Communication

<table>
<thead>
<tr>
<th></th>
<th>Academic</th>
<th>Architect</th>
<th>Developer</th>
<th>Energy Service Company</th>
<th>Investor</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.1 Communication and information flow between actors in the ES market is weak</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>E.2 ESCOs normally, approach the clients and not the other way around</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>E.3 Being able to show past profitable projects to investors is highly important for ESCOs</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>E.4 Some clients are sensitive to share data with ESCOs</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>E.5 Some clients are unwilling to learn about energy usage problems</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>E.6 Past reputation of ESCOs have hurt the industry</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>
7 FORMULATION OF HYPOTHESIS

With results from the qualitative study and expert panel, barriers and trends in the Shanghai ES market have been identified. Some are new while some have been changed to better fit the Shanghai ES market in 2013. However, the studies of the ES market in Shanghai until 2013 has been limited to exploratory studies. Variables giving rise to the barriers and trends still remain chiefly unstudied. It is argued that further investigation of the barriers and trends deemed as essential in this study for the ES market in Shanghai is of interest. Most previous studies have mainly focused on information gathered from ESCOs to draw conclusions about the PRC ES market. In this study other actors participating in the Shanghai ES market have been studied. Findings from this study point to the importance of commercial real estate developers’ knowledge and investment preferences for the growth of the ES market in Shanghai, see Table 14 and Table 15.

7.1 Hypothesis 1: Low priority investment

Results from the interview study marked investment in EE for buildings to have low priority among clients. Other measures such as improving the exterior, air quality, amenities, thermal comfort, space layout and building material was brought forward as more important aspects. The expert panel confirmed the importance of prioritizing EE among owners and developers. From these findings it became of interest to see whether developers believe EE to be of significant lower priority compared to the other measures. Suitable variables which can test the existence of such a relationship are:

- Priority Exterior
- Priority Air Quality
- Priority Amenities
- Priority Thermal Comfort
- Priority Space Layout
- Priority EE
- Priority Building Material

The hypothesis is formulated as:

\[ H_1: \text{Energy Efficiency of a building is significantly less prioritized compared to other aspects of a building among commercial real estate developers in Shanghai.} \]

The corresponding null hypothesis is formulated as:

\[ H_{01}: \text{Energy Efficiency of a building is not significantly less prioritized compared to other aspects of a building among commercial real estate developers in Shanghai.} \]

7.2 Hypothesis 2: Low operating expenses

The interview study brought forward concerns among owners and developers in Shanghai. One concern was that the operating expenses for energy is too low compared to the total revenue from the building to prioritize EE investments in Shanghai. Rather than decreasing the energy
costs, measures would rather be taken to increase the revenue. The expert panel confirmed the importance of the operating expenses for energy to be high compared to the total revenue of the building for owners and developers to prioritize ES. From these findings, it became of interest to see if developers believe the operating energy expense to be too low compared to the total revenue of the building to prioritize EE investments.

The hypothesis is formulated as:

\(H_2:\) Commercial real estate developers view the operating expenses for energy to be too low compared to the total revenue from the building to prioritize EE investments, in Shanghai.

The corresponding null hypothesis is formulated as:

\(H_{02}:\) Commercial real estate developers do not view the operating expenses for energy to be too low compared to the total revenue from the building to prioritize EE investments, in Shanghai.

7.3 Hypothesis 3: Investment horizon & investment in ES

Based on the findings from the qualitative study it is hypothesized that developers and investors investments in ES are directly hampered by the short investment horizon in commercial real estate properties. Particularly since the qualitative study showed that most of the ES in Shanghai involve a large initial investment, resulting in long payback time, which is in conflict with the short investment horizon for a majority of the investors and developers. Therefore, it is motivated that a relationship may exist in the Shanghai ES market. Suitable main variables that can test the existence of such a relationship are:

- Investment horizon (independent variable)
- Investment frequency (dependent variable)

The hypothesis is formulated as:

\(H_3:\) Commercial real estate developer’s investment horizon for buildings correlates negatively with their investment frequency in ES, in Shanghai.

The corresponding null hypothesis is formulated as:

\(H_{03}:\) Commercial real estate developer’s investment horizon for buildings does not correlate negatively with their investment frequency in ES, in Shanghai.

7.4 Hypothesis 4: Knowledge & investment in ES

Barriers previously mentioned, such as low knowledge of ES among ESCO clients, making it hard to identify the right measures for increasing the EE of the property. This in turn is leading to the hypothesis that the knowledge level of ES is correlated with the client’s rate of investment in ES. Suitable main variables that can test the existence of such a relationship are:

- Knowledge level (independent variable)
- Investment frequency (dependent variable)
The hypothesis was formulated as:

\( H_4 \): Commercial real estate developer’s knowledge level of ES correlates positively with their investment frequency in ES, in Shanghai.

The corresponding null hypothesis is formulated as:

\( H_{04} \): Commercial real estate developer’s knowledge level of ES does not correlate positively with their investment frequency in ES, in Shanghai.

7.5 Hypothesis 5: Ability to offer complete building energy system

It was found in the interview study that few ESCOs offered ES with the ability to acknowledge for the whole energy system in buildings. The expert panel confirmed that an ESCO’s ability to acknowledge for the whole energy system in buildings is of importance when deciding to invest in ES. From these results, it is of interest to test if this ability among ESCOs is important for developers.

The hypothesis was formulated as:

\( H_5 \): Commercial real estate developers in Shanghai view the ability of ESCOs to offer a complete energy system in a building as an important criterion when investing in ES.

The corresponding null hypothesis is formulated as:

\( H_{05} \): Commercial real estate developers in Shanghai do not view the ability of ESCOs to offer a complete energy system in a building as an important criterion when investing in ES.

7.6 Hypothesis 6: Ability to pay initial investment

It was found in the interview study that ESCOs often would pay for the initial investment for projects, especially in EPC. Also, ESCOs had experienced problems due to the need of financing the initial investments. Small ESCOs would even refrain from large projects partly due to the risk making a large initial investment. The expert panel also confirmed the importance of ESCOs to have good financial capabilities for their success in the Shanghai ES market. From these results it is of interest to test if in fact the ESCOs ability to pay for the initial investment is an important factor for developers when selecting an ESCO.

The hypothesis was formulated as:

\( H_6 \): Commercial real estate developers in Shanghai view it as important that the ESCO pay for the initial investment in equipment when investing in ES.

The corresponding null hypothesis is formulated as:

\( H_{06} \): Commercial real estate developers in Shanghai do not view it as important that the ESCO pay for the initial investment in equipment when investing in ES.

7.7 Hypothesis 7: Track record and profitable projects in the past

It was found in the interview study that ESCOs often need to have completed a pilot project or having a track record of profitable projects when contacting the owner or developer for them to
consider investing in ES. The expert panel confirmed the importance of ESCOs to have a profitable track record to succeed in the Shanghai ES market. From these results it is of interest to see if developers had the same priorities.

The hypothesis was formulated as:

\textbf{H}_7: \textit{Commercial real estate developers in Shanghai view it as important that the ESCO has a track record of profitable project(s) when investing in ES.}

The corresponding null hypothesis is formulated as:

\textbf{H}_07: \textit{Commercial real estate developers in Shanghai do not view it as important that the ESCO has a track record of profitable project(s) when investing in ES.}

7.8 Hypothesis 8: Government support of ES

The interview study and literature study found the governmental support to be important for the development of the ES market in Shanghai, which was confirmed by the expert panel. From these results it is of interest to see if developers share the view that the government need to support the ES market for them to invest in ES.

The hypothesis was formulated as:

\textbf{H}_8: \textit{Commercial real estate developers in Shanghai view it as important that the government supports ES for them to invest in ES.}

The corresponding null hypothesis is formulated as:

\textbf{H}_08: \textit{Commercial real estate developers in Shanghai do not view it as important that the government supports ES for them to invest in ES.}

7.9 Hypothesis 9: FM understanding of the buildings energy system

From the interview study it was found that the FM often is outsourced and the knowledge among the FM concerning the energy systems operation, maintenance, and technology to be low. Furthermore, the expert panel pointed to the level of knowledge among FM concerning operation, maintenance and technology to be essential. This makes it interesting to see whether developers generally view the FM understanding of operation, maintenance and technical aspects of the buildings energy system to be important.

The hypothesis was formulated as:

\textbf{H}_9: \textit{Commercial real estate developers in Shanghai view FM understanding of operation, maintenance and technical aspects of the buildings energy system to be important.}

The corresponding null hypothesis is formulated as:

\textbf{H}_09: \textit{Commercial real estate developers in Shanghai do not view FM understanding of operation, maintenance and technical aspects of the buildings energy system to be important.}
8 QUANTITATIVE STUDY

METHODOLOGY

The quantitative study was designed as a probabilistic survey testing hypothesis H\textsubscript{1} to H\textsubscript{9}. The survey was distributed electronically by email to a random sample of 40 commercial real estate development companies in Shanghai.

8.1 Quantitative study

The unit of analysis for the quantitative study was Senior Persons (SP2) in real estate development companies in Shanghai.

INFOBOX C: Senior Person (SP2)

The criteria for a SP2 were determined to

a) Minimum of three years of work experience
b) Senior/Managerial position in a real estate development company
c) Knowledge of the company’s investments

The criteria for a SP2 were set for the statistical data to be gathered from informants in the real estate development industry that have a good knowledge or are in direct control of investments in the ES market. This way problems arising from data gathering at the individual level and trying to generalizing it to a company level commonly referred to as ecological fallacy problem could be avoided. (Babbie, 1990; Robinson, 1950)

The sample frame, was based on a list of registered real estate development enterprises in Shanghai approved by the Shanghai Housing Security and the Housing Authority\textsuperscript{1} accessed from the 11\textsuperscript{th} – 12\textsuperscript{th} of April 2013. The list contained a total of \(N=4697\) real estate development companies. A similar list was also available through the National Bureau of Statistics of China\textsuperscript{2} under the National Classification System\textsuperscript{3}, Industrial Classification for National Economic Activities (ICNEA) where the code K 7010 Real Estate Development and Management\textsuperscript{4} refers to the real estate development enterprises in the housing, infrastructure construction development, and transfer of real estate development projects or selling out rent housing and

\textsuperscript{1}上海市住房保障和房屋管理局
\textsuperscript{2}中华人民共和国国家统计局
\textsuperscript{3}国民经济行业分类
\textsuperscript{4}房地产开发经营
other activities. However, this list was not accessible to the public. Instead the list from the Shanghai Housing Security and the Housing Authority was used. This list had several shortcomings:

- Both active and inactive companies present
- No sorting capability by company type e.g. public, private, and commercial etc.
- Low level of contact details available

8.1.1 Population Estimate

The list was manipulated to predict the number of active real estate development enterprises in Shanghai. A non-probability random sampling with a sample size of \( N=200 \) was conducted. The company name which the list provided was used with two search engines; www.google.com and www.baidu.cn. The first 20 results were investigated for information about the company. The company name was searched in Putonghua and English using Google translate. A total of 40 commercial real estate development companies were extracted using this method.

An estimate of the population was calculated with statistical mathematics. Two parameters, the confidence interval and accuracy, were set to 95 percent and 12 percent. According to McClave, Benson & Sincich (2013) a five percent significance level has become a standard measure used in most sciences. The significance level governed the likelihood of the actual population of real estate development companies to be in the estimated population interval. The accuracy directly influences the size of the estimated interval. The higher the accuracy and confidence interval the larger sample is required. Equation (8.1) was used to determine the required sample size where \( n \) is the required sample size, \( z \) standard deviation, \( \delta \) accuracy, \( p \) probability. (Blom et al., 2004)

\[
n = \left( \frac{2 \cdot z}{\delta} \right)^2 \cdot p(1 - p)
\]

Equation (8.1) has to be modified since \( p \) is not known. An estimated probability, \( \hat{p} \), is introduced in Equation (8.2)

\[
n = \left( \frac{2 \cdot z}{\delta} \right)^2 \cdot \hat{p}(1 - \hat{p})
\]

The estimated probability of an entry being an active real estate development company was computed first by using the value 0.5, which maximizes the expression in Equation (8.2) (Blom et al., 2004). However, it result in an unnecessarily large sample \( N=267 \). Random test samples were drawn and \( \hat{p} \) calculated by Equation (8.3) where \( \theta_{ACTIVE} \) is the sum of active real estate development companies from the test sample and \( \theta_{TOT} \) the total number of test samples conducted.
\[ \hat{\pi} = \frac{\theta_{ACTIVE}}{\theta_{TOT}} \]  

(8.3)

As the test sample size increased a better estimate of \( \hat{\pi} \) could be used, see Table 16.

*Table 16 Development of the probability estimate and required sample size allowing for an accuracy of 12 percent at a significance interval of 95% as the sample increase*

<table>
<thead>
<tr>
<th>( \theta_{TOT} )</th>
<th>( \hat{\pi} )</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.50</td>
<td>267</td>
</tr>
<tr>
<td>20</td>
<td>0.28</td>
<td>215</td>
</tr>
<tr>
<td>100</td>
<td>0.25</td>
<td>200</td>
</tr>
<tr>
<td>200</td>
<td>0.21</td>
<td>178</td>
</tr>
</tbody>
</table>

With the data, Equation (8.4) could be used to calculate an estimated accuracy.

\[ \delta = 2 \cdot z \cdot \sqrt{\frac{\hat{\pi}(1 - \hat{\pi})}{n}} \]  

(8.4)

Using the estimated accuracy of 11.3 percent, probability estimate and entries in the list in Equation (8.5), the interval of the estimated population was determined.

\[ n = \left( \hat{\pi} \pm \frac{z}{2} \right) \cdot \alpha \]  

(8.5)

The population of active real estate development companies in Shanghai was estimated to be within the range of 931-1042 companies.

8.1.2 Sample size

A statistical approach was used to determine an appropriate sample size for the survey.

**INFOBOX D: Errors in Hypothesis Testing**

Two types of error can be made in hypothesis testing:

- **Type I** Reject the null hypothesis H0 when it is true
- **Type II** H0 is not rejected when the alternative hypothesis is true

*Source: McClave et al. (2013)*

The significance level, \( \alpha \), is the probability of making a Type I error. In the quantitative study the significance level was set to 5 percent which is a common in science. The type II error, \( \beta \), is related to the statistical power which is the probability of not making a type II error or 1 - \( \beta \). In research it is normally more severe to commit a type I error since it is claiming an effect to
be present when it is not. Type II error on the other hand is the opposite, to fail to detect an effect when it is present. (McClave et al., 2013)

The sample size itself is affected by both the statistical power and significance level. Both are parameters that the researcher is free to adjust. Third is the effect size (EFS), a measure of the discrepancy between the null hypothesis and the alternative hypothesis, or the strength of association between the populations of interest (Cohen 1988; Cohen 1992). In Table 17 a suggested sample size originally determined by Cohen (1988) is shown for corresponding EFS, statistical power and significance level.

Table 17 Suggested Sample size depending on statistical power, significance level and EFS in the study. Source: Cohen, 1988

<table>
<thead>
<tr>
<th>EFS</th>
<th>Stat. Power = 0.6</th>
<th>Stat. Power = 0.8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\alpha = 0.05$</td>
<td>$\alpha = 0.05$</td>
</tr>
<tr>
<td>Large effect</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>Medium effect</td>
<td>30</td>
<td>44</td>
</tr>
<tr>
<td>Small effect</td>
<td>179</td>
<td>271</td>
</tr>
</tbody>
</table>

While no similar study had been conducted in the PRC, it was not viable to predict the EFS by using previous sources. Batterham and Atkinson (2005) suggest using results from a pre-study or pilot survey as the best source for determining the EFS. Data from the content validity test and a pilot survey was used to estimate the EFS. Cohen’s convenience table, see Table 17, for determining an appropriate sample size categorizing the EFS as large, medium or small was used with the content validity data. A medium EFS represent an effect likely to be observed by the careful observer, a small EFS being less obvious but not trivial and the large EFS being even more apparent than a medium effect. (Cohen, 1992)

Cohen’s $d$ was used to calculate an EFS estimate for items comparing group differences, see Equation (8.6), where $\sigma$ is the populations standard deviation, $\bar{X}_j$ the mean. (Nolan & Heinzen, 2010)

$$d = \frac{\bar{X}_1 - \bar{X}_2}{\sigma}$$ (8.6)

Pearson’s product moment correlation coefficient $r$ was used to calculate an EFS estimate when comparing two or more variables for their strength of association, see Equation (8.7), where $n$ is the sample size, $\bar{X}$ and $\bar{Y}$ the mean score and $s_x$ and $s_y$ the standard deviation. (Berben, Sereika & Engberg, 2012)

$$r = \frac{\sum_i^n(X_i - \bar{X})(Y_i - \bar{Y})}{(n - 1)s_x s_y}$$ (8.7)

Spearman’s rank correlation coefficient $\rho$ was used to calculate an EFS estimate when comparing two or more variables for their strength of association when the data was ordinal or
non-normally distributed, see Equation (8.8), where the small \(x_i\) and \(y_i\) is the rank and \(\bar{x}\) and \(\bar{y}\) the mean rank. (Ferguson, 2009)

\[\rho = \frac{\sum_i(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_i(x_i - \bar{x})^2 \sum_i(y_i - \bar{y})^2}}\] (8.8)

Table 18 computed by Cohen was used to relate the value of Cramer’s \(\phi\), Cohen’s \(d\), Pearson’s \(r\) to Cohen’s three EFS categories. (Cohen, 1988)

<table>
<thead>
<tr>
<th></th>
<th>Small effect</th>
<th>Medium effect</th>
<th>Large effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson’s (r) &amp; Spearman’s (\rho)</td>
<td>0.10</td>
<td>0.30</td>
<td>0.50</td>
</tr>
<tr>
<td>Cohen’s (d)</td>
<td>0.20</td>
<td>0.50</td>
<td>0.80</td>
</tr>
</tbody>
</table>

Equation (8.9) was used to calculate an EFS for each hypothesis, see Table 19. The pilot study’s EFS was scaled to have a greater impact on the average EFS.

\[EFS_{hyp} = \frac{EFS_{validity} + 4 \cdot EFS_{pilot}}{5}\] (8.9)

<table>
<thead>
<tr>
<th>Test</th>
<th>H1</th>
<th>H2</th>
<th>H3</th>
<th>H4</th>
<th>H5</th>
<th>H6</th>
<th>H7</th>
<th>H8</th>
<th>H9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson’s (r)</td>
<td>-</td>
<td>-</td>
<td>0.46</td>
<td>0.81</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Spearman’s (\rho)</td>
<td>-</td>
<td>-</td>
<td>0.51</td>
<td>0.70</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cohen’s (d)</td>
<td>0.82</td>
<td>-1</td>
<td>1.04*</td>
<td>1.96**</td>
<td>0.75</td>
<td>1.73</td>
<td>2.94</td>
<td>1.70</td>
<td>1.70</td>
</tr>
<tr>
<td>CVR</td>
<td>0.50</td>
<td>0.80</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
</tr>
<tr>
<td>(EFS_{hyp})</td>
<td>0.76</td>
<td>0.96</td>
<td>0.93</td>
<td>1.67</td>
<td>0.70</td>
<td>1.54</td>
<td>2.51</td>
<td>1.52</td>
<td>1.52</td>
</tr>
<tr>
<td>(EFS_{average})</td>
<td>1.35</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

* Using \(r\) from pilot study and equation \(d = 2r/(1 - r^2)^{1/2}\) (Ferguson 2009)
** Using \(p\) from pilot study and equation \(d = 2p/(1 - p^2)^{1/2}\) (Ferguson 2009)

The average EFS from the pilot survey and content validity test, Large Effect \((d = 1.35)\), a significance level of \(p = 0.05\) and statistical power of 0.8 was compared to Table 17, giving a critical sample size of \(N_{crit} = 17\). The final sample size for the quantitative study was designed to allow for a response rate of 42.5 percent, which was motivated by the response rate received from the expert panel questionnaire, 43 percent. The final sample size was determined to \(N = 40\).

8.1.3 Data collection
Questionnaires were distributed electronically and sent to the informants email, see Appendix B for email templates and Appendix E for the survey. Electronically distributed questionnaires have several advantages over the use of personal interviews, mailed questionnaires and telephone surveys. They carrying a lower cost and can quick be distributed globally (Miller,
Recently, concerns regarding the reliability and validity of emailed questionnaires have been expressed. Specifically arriving from social desirability bias, the tendency of the respondents to answer questions in a manner that is viewed favorable by others, and satisficing, shortcutting the response process (Lindhjem & Navrud, 2011). However, Lindhjem & Navrud (2011) did not find any support for social desirability bias or satisficing when comparing emailed questionnaires to personal interviews. It is still a challenge to control the sampling and to ensure that the questionnaire reaches the informant and that the informant is able to view the questionnaire. (Birnbaum, 1999)

Qualtrics Survey Software was used to create, distribute and code the questionnaires. The questionnaire was first created in English with 12 multiple choices, ranking or sliding questions. The first page gave a short explanation of the study, its purpose and the study’s definition of ES. The answering process, type of question and that all answers had to be filled in before submitting was explained. Appreciation towards the respondent’s contribution to the study was mentioned and that they would be provided a gift after submission as a token of appreciation. It was also made clear that all information would be handled confidentially.

Multiple choice, ranking and sliding questions were chosen as they require the least effort by the respondent. Wording was kept simple and brief. Each question was provided an explanation. The questions were arranged from general to more specific inquires. Control variables were used as a measure to categorize the respondents into groups (e.g. type of developer and size of company) and their knowledge of ESCOs.

In order to detect satisficing responses a timer and control question with one obvious correct and several obviously incorrect choices accompanied each questionnaire. An unreasonably short completion time or suspicious answers to the control question could indicate bias in the responses. To further minimize the occurrence of mechanically answer questions in the same fashion a method of alternating the scales and questions was used, forcing the respondents to keep attention. (Forza, 2002)

The choice of scale ranged from nominal to ratio depending on the hypothesis, see Table 20.

<table>
<thead>
<tr>
<th>Scale Type</th>
<th>H1</th>
<th>H2</th>
<th>H3</th>
<th>H4</th>
<th>H5</th>
<th>H6</th>
<th>H7</th>
<th>H8</th>
<th>H9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordinal</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Interval</td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

The questionnaire was completed with two versions, English and Putonghua. The interpreter assisted with translating the questionnaire to Putonghua which was verified by a qualified native Putonghua speaker working in the EE field. The Putonghua version was distributed to all Putonghua speaking respondents. The English version was sent out to all non-Putonghua speaking respondents.
8.1.4 Pilot survey
Prior to distribution of the questionnaire to the sample a pilot test of the questionnaire was conducted. The pilot sample consisted of two colleagues and five randomly selected representatives from the sample frame. Contact with the representatives of the target sample were done according to chapter 3.2.4, page 12. Dillman (1978) suggest that colleagues are a good source to test the questionnaire for its clarity in content and structure. Colleagues were asked:

- If instructions were clear
- If questions were clear
- To rate the mental and physical effort required to complete the survey

Answers from representatives of the sample were analyzed to improve the estimate of the sample size, see chapter 8.1.2, and tendency for bias in their answers.

8.1.5 Contact with sample
40 companies were extracted from the list provided by the Shanghai Housing Security and the Housing Authority following the same principal as when the test sample was extracted, see chapter 8.1, page 84. Further effort was made to identify respondents fitting the requirements for a SP2 from the sample of real estate development companies. Each company was further investigated for contact details, see Appendix G.

The investigation was conducted by the two researchers and followed the same search method as described in chapter 8.1. The first attempt was clearly unsuccessful to identify SP2, see Appendix I, similar to the empirical results from the qualitative study where the sample was acting as a hidden population. Information regarding employees seemed to be hidden and not publicly available. However, most companies (39) had a telephone number for general inquires and a bit more than half (25) had a general email address. In order to solve the difficulty to contact a SP2 in the companies experience from the qualitative study was adapted. Contacting the reception is difficult unless done in Putonghua.

According to Dillman (1978) correspondence with informants are to be viewed in a social context. A high response rate can be achieved by (Dillman, 1978):

A3 Rewarding the respondent by giving verbal appreciation, offering tangible reward and supporting his or her values
B3 Reducing the cost for the respondent to complete a questionnaire by reducing the physical and mental efforts to complete the survey and eliminate any direct monetary cost
C3 Establish trust by providing a token of appreciation in advance, identifying with a known organization that has legitimacy or building on other relationships

Flynn et al. (1990; 1997) also suggest implementing a contact strategy for how to contact potential respondents and obtain their commitment to complete the questionnaire before distribution. Extra effort should be made to ensure that the respondent understand the purpose of the study (D3) which may help with trust issues. (Flynn et al., 1990; Flynn et al., 1997)
A strategy was set up where the interpreter was instructed to contact the reception and inquire about a senior personnel and its contact information. Before contacting the reception the interpreter received guidelines to use during the calls and instructions to visit each webpage and learn about the company prior to a call, an effort to avoid bias arriving from the contact approach varying with each attempt. If the call was unsuccessful inquiry was to be made why, an effort to detect bias. The telephone guidelines can be found in Appendix H:

The second attempt was unsuccessful in gathering contact details for the sample, see Appendix I. In Table 21 details for why it was not possible to receive contact details are shown.

<table>
<thead>
<tr>
<th>Motive</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of contact required</td>
<td>13</td>
<td>32.5</td>
</tr>
<tr>
<td>Send to generic Email</td>
<td>13</td>
<td>32.5</td>
</tr>
<tr>
<td>SP2 do not have time</td>
<td>7</td>
<td>17.5</td>
</tr>
<tr>
<td>No telephone number available</td>
<td>5</td>
<td>12.5</td>
</tr>
<tr>
<td>No person fit the SP2 criteria</td>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>

It was shown that often the name of the person to contact was required to receive any contact details, similar to the experience from the qualitative study where the response rate was considerably higher when a relationship to the respondent existed. In slightly more than 30 percent of the attempts it was advised to send the questionnaire to the company’s general email address. However, sending a questionnaire by email to a company’s generic inbox is less than optimal and a source of bias from not knowing to whom it may be forward, if any. Also, Dillman (1978) press on the importance of including the name of the respondent in a questionnaire. Without the name of the respondent, there is a high probability that the questionnaire will be lost or delivered to a person which is not interested or has no knowledge on the subject. (Dillman, 1978)

Two different approaches were used. First an email to be sent to the company’s generic email was carefully compiled in English and Putonghua considering the design suggested by Dillman (1978). The basic structure was:

- A brief explanation of the study, the study’s *institutional endorsers and purpose*
- Inform about the questionnaire short length and time estimate of 5 minutes
- Inquire about the possibility to forward the questionnaire to a *senior person*
- Encourage the respondent to accept the interview and inform that all participants would receive a gift and other benefits
- Inform that participation was *anonymous* and brief information about the researchers

A new set of questionnaires were made to distinguish the responses arriving from questionnaires sent to company generic emails and those sent directly to a SP2 email.
Secondly names of SP2 were identified through LinkedIn, a social networking webpage for professionals. Searching for the company names within the sample gave access to employees LinkedIn profile with information about current employment, name and position.

In Table 22 the result of using LinkedIn to identify the name of a senior person is shown.

<table>
<thead>
<tr>
<th>Information</th>
<th>Successful</th>
<th>Unsuccessful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name SP2</td>
<td>25</td>
<td>15</td>
</tr>
<tr>
<td>Position SP2</td>
<td>25</td>
<td>15</td>
</tr>
</tbody>
</table>

Each company in the sample was contacted by telephone a second time. The second time the name of the contact person was given for companies where it was known, see Appendix I.

A third call was made to contact the senior person directly to establish a relationship and urge them to complete the questionnaire. After one week, a reminder was sent out by email urging the respondent to complete the questionnaire.

Table 23 & Table 24 shows the responses and response rate for the questionnaire sent to the generic email and the questionnaire sent directly to the SP2.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Responded</th>
<th>Not Responded</th>
<th>Response Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP Email</td>
<td>7</td>
<td>33</td>
<td>17.5 %</td>
</tr>
<tr>
<td>First Reminder</td>
<td>12</td>
<td>28</td>
<td>30 %</td>
</tr>
<tr>
<td>Final Reminder</td>
<td>18</td>
<td>22</td>
<td>45 %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stage</th>
<th>Responses</th>
<th>Not Responded</th>
<th>Response Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generic Email</td>
<td>1</td>
<td>39</td>
<td>2.5 %</td>
</tr>
<tr>
<td>First Reminder</td>
<td>2</td>
<td>38</td>
<td>5 %</td>
</tr>
<tr>
<td>Final Reminder</td>
<td>3</td>
<td>37</td>
<td>7.5 %</td>
</tr>
</tbody>
</table>

8.1.5.1 Data Coding & Analysis

The survey responses were automatically saved and exported with Qualtrics software. The data was imported and analyzed using IBM SPSS 22. Preliminary analysis included analysis of central tendencies, dispersion, frequency distribution and correlations. Cronbach coefficient alpha, \( \alpha \), was calculated to measure the equivalence, homogeneity and inter-correlation of the data hence assessing its reliability (Nunnally, 1978).

Non-parametric and parametric analysis was conducted for the hypothesis testing. Paired Student T test was conducted to test \( H_{01} \). One sample Student T difference test and one sample
Wilcoxon difference test was conducted to test $H_{02}; H_{05} - H_{09}$. Directional correlation tests testing for Pearson’s and Spearman’s correlation coefficient was conducted to test $H_{03} - H_{04}$. 
9 QUANTITATIVE STUDY RESULT

In order to test the nine hypotheses, responses from the questionnaire was analyzed by comparing their rank, means and correlation with the assistance of non-parametric and parametric tests. All hypotheses were subject to a significant criterion of $\alpha = 0.05$, both for one- and two tailed tests.

9.1 Low priority investment

Hypothesis 1 ($H_1$) predicts that EE is not prioritized among commercial real estate developers in Shanghai. This means that commercial real estate companies rather spend their budget in other areas of a building, before committing to an effort of increasing the EE of the building.

A paired Student T parametric difference test imposed on the null hypothesis ($H_{01}$): *Energy Efficiency of a building is not significantly less prioritized compared to other aspects of a building among commercial real estate developers in Shanghai*. EE was pairwise compared with; Amenities, Exterior, Space Layout, Air Quality, Thermal Comfort and Building Material areas found to be important to commercial real estate developers in Shanghai from the qualitative study.

Results of the paired Student T difference test are presented in Table 25. A 95 percent confidence interval of the difference between the items is shown as well as the 2-tailed significance level of the difference between the variables. A positive lower and upper value for the 95 percent confidence interval of the difference signifies that the item being compared to EE within a 95 percent confidence level is deemed as more prioritized than EE measures.

Support was found for $H_1$ as $H_{01}$ could be rejected at $p < 0.05$. All of the items, except for ‘Building material’ displayed a higher priority among commercial real estate developers in Shanghai, within a 95 percent confidence level.

*Table 25 Paired Student T Difference Test, testing for significant difference between investment priority of EE and other measures among commercial real estate developers in Shanghai.*

<table>
<thead>
<tr>
<th>Paired Differences</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
<th>95% Confidence Interval of the Difference</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Efficiency – Amenities</td>
<td>2.29</td>
<td>1.19</td>
<td>.26</td>
<td>1.74, 2.83</td>
<td>8.81</td>
<td>20</td>
<td>.000</td>
</tr>
<tr>
<td>Energy Efficiency – Exterior</td>
<td>3.00</td>
<td>3.00</td>
<td>.65</td>
<td>1.63, 4.37</td>
<td>4.58</td>
<td>20</td>
<td>.000</td>
</tr>
<tr>
<td>Energy Efficiency - Space Layout</td>
<td>1.71</td>
<td>2.17</td>
<td>.47</td>
<td>.73, 2.70</td>
<td>3.62</td>
<td>20</td>
<td>.002</td>
</tr>
<tr>
<td>Energy Efficiency - Air Quality</td>
<td>1.71</td>
<td>2.55</td>
<td>.56</td>
<td>.55, 2.88</td>
<td>3.08</td>
<td>20</td>
<td>.006</td>
</tr>
<tr>
<td>Energy Efficiency - Thermal Comfort</td>
<td>1.86</td>
<td>3.21</td>
<td>.70</td>
<td>.39, 3.32</td>
<td>2.65</td>
<td>20</td>
<td>.015</td>
</tr>
<tr>
<td>Energy Efficiency - Building Material</td>
<td>.43</td>
<td>1.72</td>
<td>.38</td>
<td>-.35, 1.21</td>
<td>1.14</td>
<td>20</td>
<td>.267</td>
</tr>
</tbody>
</table>

*NOTE: (Seven-point scales were used, where 1=Most Prioritized, 7=Least Prioritized)*
9.2 Operating expenses for energy are too low to prioritize EE investment
Hypothesis 2 ($H_2$) predicts that EE is not prioritized among commercial real estate developers in Shanghai due to energy expenses being too small compared to the revenue generated from a building. Meaning that investment in EE has a low potential of affecting a commercial real estate developers profit.

A one sample parametric and non-parametric difference test was imposed on the null hypothesis ($H_{02}$): Commercial real estate developers do not view the operating expenses for energy to be too low compared to the total revenue from the building to prioritized EE investments, in Shanghai.

Results from the one sample parametric and non-parametric difference tests are presented in Table 26 and Table 27. In Table 26 a 95 percent confidence interval of the difference from the test items is shown as well as the 2-tailed significance level of rejecting the null hypothesis when it is true. A negative lower and upper value for the 95 percent confidence interval of the difference signifies that the commercial real estate developers disagree to the statement.

Support was not found for $H_2$ as $H_{02}$ could not be rejected, $p < 0.05$. Instead it revealed that within a 95 percent confidence level commercial real estate developers disagree that the operating energy expenses would be too high to prioritize EE investments.

Table 26 One Sample Student $T$ Parametric Difference Test, testing commercial real estate developer’s view on the statement that operating energy expenses are too low compared to total revenue from the building to prioritize EE investments.

<table>
<thead>
<tr>
<th>Test Item</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
<th>Mean Difference</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy expense compared to total revenue</td>
<td>-4.83</td>
<td>20</td>
<td>.000</td>
<td>-1.00</td>
<td>Lower: -1.43, Upper: -.57</td>
</tr>
</tbody>
</table>

**NOTE:** The question was posed as follows: The operating expenses for energy compared to the total revenue generated from the building is not high enough to prioritize energy efficient investments (Five-point Likert scales were used, where 1=Strongly Disagree, 5=Strongly Agree)

Table 27 One Sample Wilcoxon Non-Parametric Difference Test, testing commercial real estate developer’s view on the statement that operating energy expenses are too low compared to total revenue from the building to prioritize EE investments.

<table>
<thead>
<tr>
<th>Test Item</th>
<th>z</th>
<th>N</th>
<th>Sig. (1-tailed)</th>
<th>Std. Deviation</th>
<th>$W_L$</th>
<th>$W_U$</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy expense compared to total revenue</td>
<td>3.19</td>
<td>21</td>
<td>&lt;.005</td>
<td>57.54</td>
<td>207.0</td>
<td>24.0</td>
<td>-183.0</td>
</tr>
</tbody>
</table>

**NOTE:** The question was posed as follows: The operating expenses for energy compared to the total revenue generated from the building is not high enough to prioritize energy efficient investments (Five-point Likert scales were used, where 1=Strongly Disagree, 5=Strongly Agree)

9.3 Short term investment horizon decrease investments in ES
Hypothesis 3 ($H_3$) predicts that a positive correlation exist between the investment horizon for buildings among commercial real estate developers in Shanghai and their investment in ES. This means that you can expect a commercial real estate development company with long...
investment horizon to invest comparatively more in ES than one with a short investment horizon.

A parametric and non-parametric directional correlation test was imposed on the null hypothesis ($H_{03}$): *Commercial real estate developer’s investment horizon for buildings does not correlate negatively with their investment frequency in ES, in Shanghai.* Each respondent’s investment horizon for buildings was compared to their investment frequency in ES.

Results of the directional correlation test are presented in Table 28. Both Pearson’s correlation coefficient $r$ and Spearman’s correlation coefficient $\rho$ are presented as well as a 1 tailed significance level. A positive value between 0 and 1 for $r$ and $\rho$ signifies a positive correlation between investment horizon and investment in ES.

Support was found for $H_3$ as $H_{03}$ could be rejected, $p < 0.05$. Both Pearson’s $r$ and Spearman’s $\rho$ signified the existence of a positive correlation between investment horizon and investment in ES within a 95 percent confidence level.

9.4 High knowledge of ES leads to more investments in ES

Hypothesis 4 ($H_4$) predicts that a positive correlation exist between the knowledge level of ES among commercial real estate developers in Shanghai and their investment in ES. This means that you can expect a commercial real estate development company with a high knowledge of ES to invest comparatively more in ES compared to one with low knowledge of ES.

A parametric and non-parametric directional correlation test was imposed on the null hypothesis ($H_{04}$): *Commercial real estate developer’s knowledge level of ES does not correlate positively with their investment frequency in ES, in Shanghai.* Each respondent’s ES knowledge level was compared to their investment frequency in ES.

Results of the directional correlation test are presented in Table 29. Both Pearson’s correlation coefficient $r$ and Spearman’s correlation coefficient $\rho$ are presented as well as a 1 tailed significance level. A positive value between 0 and 1 for $r$ and $\rho$ signifies a positive correlation between investment horizon and investment in ES.
Support was found for $H_4$ as $H_{04}$ could be rejected, $p < 0.05$. Both Pearson’s $r$ and Spearman’s rho signified the existence of a positive correlation between investment horizon and investment in ES within a 95 percent confidence level.

**Table 29** Parametric and Non-Parametric Directional Correlation Test of commercial real estate developer’s ES knowledge level and Investment Frequency in Shanghai.

<table>
<thead>
<tr>
<th></th>
<th>Pearson’s $r$ Correlation Coefficient $r$</th>
<th>.806**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sig. (1-tailed)</td>
<td></td>
<td>.000</td>
</tr>
<tr>
<td>$N$</td>
<td></td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Spearman’s Correlation Coefficient rho</td>
<td>.696**</td>
</tr>
<tr>
<td>Sig. (1-tailed)</td>
<td></td>
<td>.000</td>
</tr>
<tr>
<td>$N$</td>
<td></td>
<td>21</td>
</tr>
</tbody>
</table>

**Correlation is significant at the 0.01 level (1-tailed).**

Furthermore, a one sample parametric and non-parametric difference test of the respondent’s knowledge level of ES revealed that within a significance level of $p < 0.005$, commercial real estate developers deem themselves to have a knowledge level of ES above fair, see Table 31 and Table 30.

**Table 30** One Sample Student T Parametric Difference Test, testing commercial real estate developer’s knowledge level of ES.

<table>
<thead>
<tr>
<th></th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
<th>Mean Difference</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge level</td>
<td>4.18</td>
<td>20</td>
<td>.000</td>
<td>1.00</td>
<td>.50 1.50</td>
</tr>
</tbody>
</table>

NOTE: The question was posed as follows: What level is your company’s knowledge of ES? (Five-point Likert scales were used, where 1=Very Poor, 5=Very Good)

**Table 31** One Sample Wilcoxon Non-Parametric Difference Test, testing commercial real estate developer’s knowledge level of ES.

<table>
<thead>
<tr>
<th></th>
<th>z</th>
<th>N</th>
<th>Sig. (1-tailed)</th>
<th>Std. Deviation</th>
<th>$W_L$</th>
<th>$W_U$</th>
<th>$W$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge level</td>
<td>3.06</td>
<td>18</td>
<td>&lt;.005</td>
<td>45.92</td>
<td>15.0</td>
<td>156.0</td>
<td>141.0</td>
</tr>
</tbody>
</table>

NOTE: The question was posed as follows: What level is your company’s knowledge of ES? (Five-point Likert scales were used, where 1=Very Poor, 5=Very Good)

9.5 Hypotheses 5-9

Hypothesis 5 ($H_5$) predicts that commercial real estate developers in Shanghai view the ability of ESCOs to offer a complete energy system in a building as an important criteria when deciding to invest in ES.
Hypothesis 6 (H₆) predicts that commercial real estate developers in Shanghai view it as important that the ESCOs pays for the initial investment of equipment for them to invest in ES.

Hypothesis 7 (H₇) predicts that commercial real estate developers in Shanghai view it as important that the ESCO has a track record of profitable project(s) for them to invest in ES.

Hypothesis (H₈) predicts that commercial real estate developers in Shanghai view government support in ES as important for them to invest in ES.

Hypothesis 9 (H₉) predicts that commercial real estate developers in Shanghai view FM understanding of operation, maintenance and technical aspects of the building system to be important.

The null hypotheses for hypotheses 5-9, see chapter 7 page 81-82, were all tested with a parametric and non-parametric difference test. Results from the one sample parametric and non-parametric difference tests are presented in Table 32 and Table 33. In Table 32 a 95 percent confidence interval of the difference from the test items is shown as well as the 2-tailed significance level of rejecting the null hypothesis when it is true. A negative lower and upper value for the 95 percent confidence interval of the difference signifies that the commercial real estate developers in Shanghai disagree to the statement.

Support was found for H₅ – H₉ as H₀₅ – H₉ could be rejected at a significance level p < 0.005. The Wilcoxon directional test, see Table 33 and Student T test, Table 32. This revealed that commercial real estate developers in Shanghai view it as important:

- That the ESCO is able to offer a complete building energy system when investing in ES.
- That the ESCO pays for the initial investment in equipment when investing in ES
- That the ESCO has a track record of profitable project(s) for them to invest in ES.
- That the government support ES for them to invest in ES.
- That the FM understanding of operation, maintenance and technical aspects of the building system.
Table 32 One Sample Student T Parametric Difference Test, testing opinion among commercial real estate developer’s in Shanghai.

<table>
<thead>
<tr>
<th>Test Value = 3 “Neither Important nor Unimportant”</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
<th>Mean Difference</th>
<th>95% Confidence Interval of the Difference</th>
<th>Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Service Company can offer a complete system</td>
<td>3.63</td>
<td>20</td>
<td>.002</td>
<td>.71</td>
<td>.30</td>
<td>1.13</td>
<td></td>
</tr>
<tr>
<td>Energy Service Company pay the initial investment of equipment</td>
<td>8.37</td>
<td>20</td>
<td>.000</td>
<td>1.00</td>
<td>.75</td>
<td>1.25</td>
<td></td>
</tr>
<tr>
<td>Energy Service Company has a track record of profitable projects</td>
<td>14.20</td>
<td>20</td>
<td>.000</td>
<td>1.57</td>
<td>1.34</td>
<td>1.80</td>
<td></td>
</tr>
<tr>
<td>Energy Service Company is less renown than your company</td>
<td>-3.51</td>
<td>20</td>
<td>.002</td>
<td>-.57</td>
<td>-.91</td>
<td>-.23</td>
<td></td>
</tr>
<tr>
<td>Government supports investments in Energy Services</td>
<td>8.22</td>
<td>20</td>
<td>.000</td>
<td>1.29</td>
<td>.96</td>
<td>1.61</td>
<td></td>
</tr>
<tr>
<td>Facility Management understanding of Operation, Maintenance and Technical aspects</td>
<td>8.22</td>
<td>20</td>
<td>.000</td>
<td>1.29</td>
<td>.96</td>
<td>1.61</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** (Five-point Likert scales were used, where 1=Not at all important, 5=Extremely Important)

Table 33 One Sample Wilcoxon Non-Parametric Difference Test, testing opinion among commercial real estate developer’s in Shanghai.

<table>
<thead>
<tr>
<th>Test Value = 3 “Neither Important nor Unimportant”</th>
<th>z</th>
<th>N</th>
<th>Sig. (1-tailed)</th>
<th>Std. Deviation</th>
<th>W_L</th>
<th>W_U</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Service Company can offer a complete system</td>
<td>2.67</td>
<td>18</td>
<td>&lt;.005</td>
<td>45.92</td>
<td>24.0</td>
<td>147.0</td>
<td>123.0</td>
</tr>
<tr>
<td>Energy Service Company pay the initial investment of equipment</td>
<td>3.71</td>
<td>18</td>
<td>&lt;.0005</td>
<td>45.92</td>
<td>.0</td>
<td>171.0</td>
<td>171.0</td>
</tr>
<tr>
<td>Energy Service Company has a track record of profitable projects</td>
<td>4.01</td>
<td>21</td>
<td>&lt;.0005</td>
<td>57.54</td>
<td>.0</td>
<td>231.0</td>
<td>231.0</td>
</tr>
<tr>
<td>Energy Service Company is less renown than your company</td>
<td>2.64</td>
<td>9</td>
<td>&lt;.005</td>
<td>16.88</td>
<td>45.0</td>
<td>.0</td>
<td>-45.0</td>
</tr>
<tr>
<td>Government supports investments in Energy Services</td>
<td>3.71</td>
<td>18</td>
<td>&lt;.0005</td>
<td>45.92</td>
<td>.0</td>
<td>171.0</td>
<td>171.0</td>
</tr>
<tr>
<td>Facility Management understanding of Operation, Maintenance and Technical aspects</td>
<td>3.71</td>
<td>18</td>
<td>&lt;.0005</td>
<td>45.92</td>
<td>.0</td>
<td>171.0</td>
<td>171.0</td>
</tr>
</tbody>
</table>

**NOTE:** (Five-point Likert scales were used, where 1=Not at all important, 5=Extremely Important)

9.6 Other findings
Apart from the hypothesized findings, the survey contained a two segments asking about the commercial real estate developers motives in the past for using ES and the resulting effect of having used ES in the past.

A one sample student t difference test showed a significant result for Energy Cost, Property Value, Quality, Rental Premise and Reputation to be important motives among commercial real estate developers in Shanghai to have used ES in the past, see Table 34. However Subsidies could not be ruled out to be an unimportant motive for using ES in the past at a significance level $p < 0.05$.

To further investigate the motives of using ES in the past it was investigated if reducing Energy Cost was significantly more important than the other motives for using ES. A paired student t
difference test was used. Results shown in Table 35 only displayed a significant result of Energy Cost being a more important motive than Subsidies. It also showed a significant result that Energy Cost was a less important motive than Reputation, Quality and Rental Premise when using ES in the past.

Table 34 One Sample Student T Parametric Difference Test, testing commercial real estate developer’s past motive for using ES.

<table>
<thead>
<tr>
<th></th>
<th>Test Value = 3 &quot;Neither important nor Unimportant&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t</td>
</tr>
<tr>
<td>Energy Cost</td>
<td>3.69</td>
</tr>
<tr>
<td>Subsidies</td>
<td>0.77</td>
</tr>
<tr>
<td>Property Value</td>
<td>7.14</td>
</tr>
<tr>
<td>Quality</td>
<td>11.66</td>
</tr>
<tr>
<td>Rental Premise</td>
<td>8.10</td>
</tr>
<tr>
<td>Reputation</td>
<td>20.28</td>
</tr>
</tbody>
</table>

NOTE: The question was posed as follows: How important were the following motives for the use of ES in your company in the past? (Five-point Likert scales were used, where 1= Not at all important, 5= Extremely Important)

Table 35 Paired Student T Parametric Difference Test, testing for significant difference between ES investment motive of EE and other measures among commercial real estate developers in Shanghai.

<table>
<thead>
<tr>
<th>Paired Differences</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
<th>95% Confidence Interval of the Difference</th>
<th>T</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Cost - Subsidies</td>
<td>.50</td>
<td>.79</td>
<td>.19</td>
<td>.11 .89</td>
<td>2.70</td>
<td>17</td>
<td>.015</td>
</tr>
<tr>
<td>Energy Cost - Property Value</td>
<td>-.33</td>
<td>1.28</td>
<td>.30</td>
<td>-.97 .30</td>
<td>-.10</td>
<td>17</td>
<td>.286</td>
</tr>
<tr>
<td>Energy Cost - Quality</td>
<td>-.67</td>
<td>.77</td>
<td>.18</td>
<td>-1.05 -.29</td>
<td>-3.69</td>
<td>17</td>
<td>.002</td>
</tr>
<tr>
<td>Energy Cost - Rental Premise</td>
<td>-.83</td>
<td>1.25</td>
<td>.29</td>
<td>-1.45 -.21</td>
<td>-2.83</td>
<td>17</td>
<td>.012</td>
</tr>
<tr>
<td>Energy Cost - Reputation</td>
<td>-1.17</td>
<td>.92</td>
<td>.22</td>
<td>-1.63 -.71</td>
<td>-5.36</td>
<td>17</td>
<td>.000</td>
</tr>
</tbody>
</table>

NOTE: The question was posed as follows: How important were the following motives for the use of ES in your company in the past? (Five-point Likert scales were used, where 1= Not at all important, 5= Extremely Important)

To test the effect of using ES in the past among commercial real estate developers a one sample student t difference test was used. All items that had been a motive for using ES in the past were checked. A significant increase was witnessed for energy cost, property value, quality, rental premise and reputation, see Table 36. The outcome of using ES in the past had contributed to a positive change for all items except energy cost, since it had increased as an effect of using ES.
Table 36 One Sample Student T Parametric Difference Test, testing commercial real estate developer’s past effect of using ES.

<table>
<thead>
<tr>
<th></th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
<th>Mean Difference</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Cost</td>
<td>3.69</td>
<td>17</td>
<td>.002</td>
<td>.67</td>
<td>.29, 1.05</td>
</tr>
<tr>
<td>Subsidies</td>
<td>.77</td>
<td>17</td>
<td>.454</td>
<td>.17</td>
<td>-.29, .63</td>
</tr>
<tr>
<td>Property Value</td>
<td>7.14</td>
<td>17</td>
<td>.000</td>
<td>1.00</td>
<td>.70, 1.30</td>
</tr>
<tr>
<td>Quality</td>
<td>11.66</td>
<td>17</td>
<td>.000</td>
<td>1.33</td>
<td>1.09, 1.57</td>
</tr>
<tr>
<td>Rental Premise</td>
<td>8.10</td>
<td>17</td>
<td>.000</td>
<td>1.50</td>
<td>1.11, 1.89</td>
</tr>
<tr>
<td>Reputation</td>
<td>20.28</td>
<td>17</td>
<td>.000</td>
<td>1.83</td>
<td>1.64, 2.02</td>
</tr>
</tbody>
</table>

NOTE: The question was posed as follows: What was the effect of using ES in your company in the past? (Five-point Likert scales were used, where 1= Much Less, 5= Much More)
10 CONCLUSIONS & DISCUSSION

In the following chapter, the conclusions are disclosed. These are based upon the results found throughout both the qualitative and quantitative study. The conclusions involve barriers, opportunities and actors on the ES market in Shanghai.

10.1 Energy service market actors in Shanghai

Two distinctive actor maps, see Figure 19 and Figure 20 on page 72 resp. 74, were drawn from results found in the literature and interview studies. The maps were also confirmed by the expert panel. It was found that actors involved and their interaction among them during an ES project depended on whether it was a new construction or a retrofit project. Compared to the actor map by WBCSD, see Figure 9 on page 24, local tendencies for the Shanghai ES market were identified.

During the construction phase of a new construction the ESCO have less involvement with the Shanghai fund and government administrations compared to a retrofit project. In a retrofit project the ESCO is often involved in EPC. If the ESCO fulfill requirements, such as reducing the energy usage of the building, the Shanghai fund and government administrations may grant them subsidies. The situation is different in new constructions where ES may be used by the developer to gain a certification according to the Three star system, a certification which the Shanghai fund and administration primarily grant the developer subsidies for accomplishing. Hence, in a new construction the ESCO typically has a different interaction pattern among the actors even if the actors involved are similar, see Figure 19 and Figure 20 on page 72 resp. 74.

Another difference identified compared to what is found in previous literature, is that the building owner seldom constitutes the end-user of the building. Instead the building space is typically leased to a tenant with low incentives for improving the EE of the building.

10.2 ESCO barriers

Based on interviews, it became evident that some of barriers mentioned in the literature were confirmed, while others were no longer valid. Some barriers mentioned in the literature were not mentioned in the interviews, thus they could neither be confirmed nor rejected. Furthermore, some barriers not mentioned previously in the literature were identified in the interview study and are regarded as new barriers. Invalid, confirmed, unconfirmed and new barriers to the ES market in Shanghai are shown in Table 37 on page 108 together with a comparison between the barriers for ESCOs in the Swedish ES market.
10.2.1 Confirmed barriers
Some barriers from the literature were confirmed by the interview and quantitative study.

Market barriers

The barrier 1.1 Poor energy pricing was mentioned in the literature study as a market barrier. This view was also expressed in the interview study by several interviewees who mentioned the electricity price as being strictly regulated by the government and held at a low level. A problem since the energy price impact the potential cost saves from using ESs (Academic 1 & 2; ESCO 4; Architect 2, 2013). The quantitative study \((H_2)\) found that commercial real estate developers in Shanghai generally view the operating expenses of energy to be sufficiently large compared to the total revenue generated by the building to motivate investment in ES. While the energy cost is still high enough for clients to invest in ES, the barrier 1.1 Poor Energy Pricing still exists in the Shanghai ES market.

A lack of understanding of ESCOs and their services among clients was found to lead to distrust and the barrier 1.4 Client distrust due to lack of technological understanding was identified in the literature study. This barrier was confirmed in the interview study which showed that the technological knowledge of the buildings energy system is low among building owners (Academic 1, 2, 3 & 4; ESCO 1, 4 & 5, 2013). It happens that clients cannot comprehend the measures that the ESCO is advising and this result into disbelief and mistrust (Academic 4, 2013). According to the positive correlation between commercial real estate developers knowledge level of ES and their investment frequency \((H_4)\) found in the quantitative study this barrier is likely to result in a lower degree of ES investment. Due to this the barrier 1.4 client distrust due to lack of technological understanding is confirmed.

Institutional barriers

Barrier 2.1 Laws and policies regulating SOE activity, was confirmed through the interviews. It was found that it is hard for ESCOs to do large SEO retrofit projects when vital equipment belonged to the government and therefore could not be altered (Academic 1; ESCO 2, 2013). Also, ESCOs cannot share the benefits of EPC in government owned facilities (Academic 2, 2013).

When conducting ES, there are several factors affecting the final outcome and the client may not have the knowledge to understand these factors. According to the interviews, there are standards on how to evaluate the effects of ES. However, the issued standards are not sufficient and there is a need of more comprehensive standards (Academic 4; ESCO 2, 2013). Thus, the barrier 2.3 Hard to evaluate effects of ES due to lack of standards was considered as confirmed.

It was confirmed in the interviews that 2.4 Inadequate contract procedures still exist on the Shanghai ES market. However, it used to be more common in the past and it rarely causes disputes nowadays, especially not when larger firms are involved. The reason for the contract disputes is that the measurements in the contract are not well termed (Academic 4 & 5, 2013). As it is still hard to evaluate the effects of ES, a well termed contract is of great importance.

Financial barriers
A recurring barrier in found both in the literature study and interview study is the difficulty for ESCOs to value ES. This is mainly due to variables affecting the energy usage being hard to predict such as outdoor temperature, occupational density, production etc. (Academic 4 & 5, 2013). But also due to the client not understanding how external factors influence the energy cost, which may lead to conflict (Academic 4, 2013). Finally, when valuating ES, the cost saving is not the only factor giving value to the ES, other factors such as indoor climate also impact the value (Investor). Support for the notion of ES having a value apart from resulting in energy savings was found in the quantitative study (other findings). It was even shown that commercial real estate developers regard increased building quality, rental premise and reputation as greater motive for using ES than reducing the energy cost. Therefore, the barrier 3.2 Hard to value ES is concluded to still exist in the Shanghai ES market.

Many of the ES offered in the Shanghai ES market have a long payback time and require a large initial investment (Academic 1; ESCO 5; Investor, 2013). The high upfront costs related to these ES constitute a barrier in the market. The barrier was found both in the literature and interview study. The client is reluctant to pay for the initial investment and prefer if the ESCO is able to pay for it (Investor, 2013). This was furthered supported by the quantitative study which found commercial real estate developers to view the ability among ESCOs to pay for the initial investment as important for them to invest in ES. Combined with the difficulty of acquiring loans, which has been and to some extent still is a problem among ESCOs, the barrier 3.3 High up-front costs can be concluded to still exist in the Shanghai ES market.

The short investment horizon among clients was found to be a problem in the interview study. The building owners would seldom consider projects without a payback time of 3-5 years (Investor, 2013). At the same time ESCOs typical payback time in the Shanghai market is about two times the acceptable payback time for owners (Academic 2; ESCO 4; Investor, 2013). The quantitative study ($H_3$) found a significant positive correlation with the investment horizon among commercial real estate developers and their investment frequency for ES. This shows that the barrier 3.4 Client has short investment horizon does not just exist, but is a severe barrier in the Shanghai ES market.

**Technology barriers**

Many of the services offered by ESCOs are too expensive for many of the potential clients on the market (Architect 1, 2013). Due to this, it becomes apparent that 4.2 Lack of affordable energy efficiency technology is still an existing barrier in Shanghai. Especially considering that the EE technology offered in Shanghai is not as modern and efficient as in Europe or the US. (Academic 5, 2013)

It was assumed based on the interviews that there is still a lack of qualified professionals. Even if this was not explicitly mentioned, it was clear that many of the ESCOs were proud of having employees with a high degree of academic merit, it was considered an exception to have as qualified professionals. Due to this, barrier 4.3 ESCOs lack qualified professionals is still present.
Barrier 4.4 *Hard for customers to evaluate ESCO products* was identified as a technology barrier in the literature study. Findings from the interview study later confirmed the barrier to exist in the Shanghai ES market. It was found that communication and information was poor among actors in the market, at the same time the technical knowledge among clients was low, combined with many similar technologies existing in the market clients faced difficulty when trying to evaluate different ESCO products (Academic 1, 2, 3 & 4; Architect, 2013). The quantitative study \((H_4)\) also found that commercial real estate developers view it as important that ESCOs have a track record of profitable projects for the commercial real estate developers to invest in ES. This can be related to the barrier since clients show that they are not confident in evaluating ESCO products without the support of a track record. Therefore, the barrier 4.4 *Hard for customers to evaluate ESCO products* still exists in the market.

### 10.2.2 Invalid barriers

Some of the barriers found in the literature were not specific for the Shanghai ES market but rather the whole PRC and may therefore not be applicable in Shanghai. Others are outdated or may even be inaccurate from the beginning. The barriers mentioned in this chapter are either invalid or not strong enough to be classified as important based on the findings from the interviews expert panel and quantitative study.

*Market barriers*

As the number of ESCOs in Shanghai is increasing, so is the awareness of ES for the persons responsible for the buildings. The government in the PRC is working hard to increase awareness through flagship building projects, promotions, by mentioning EPC in the FYPs and by giving favorable incentives etc. (Developer; ESCO 3, 2013). The knowledge of ESCOs and their services in Shanghai is therefore rising and this should soon, if not already, no longer be one of the main barriers for ESCOs, especially not in developed cities such as Shanghai. This view was also supported by results from the quantitative study \((H_4)\) which show that commercial real estate developers in Shanghai view their knowledge level of ES as fair or greater. None of the interviewees considered this a problem and due to this, 1.2 *Low awareness and lack of information* is not qualified as a main barrier.

It is no longer hard to convince clients of the potential of ES. They know about ES and they know how the general EPC system works. It is hard to sell smaller projects, such as changing the lighting. However, that is due to the clients already knowing what to do (ESCO 3, 2013). Due to this 1.3 *Hard to convince clients about the potential of ES* does not qualify as a typical barrier for ESCOs, rather it is more about the information flow between actors, see barrier 1.8.

1.5 *Clients break their contracts* has according to the interviews been a problem in the past (Academic 4 & 5; ESCO 1 & 2, 2013). Recently, there have been improvements with better contract procedures, guides and standards (ESCO 2, 2013) which in turn have led to less breaking of contracts. It is also rare that big client would break their contract (Academic 4 & 5, 2013). Contractual breaking still exists, but it can no longer be considered a major problem or a main barrier.
Financial barriers

During the last two years, the local government in Shanghai has issued numerous of policies to encourage ES and to help ESCOs to acquire loans from banks (ESCO 2 & 4, 2013). It is still problematic for smaller ESCOs (Academic 1; ESCO 1 & 2, 2013) but it is getting easier for them as well as the banks are still learning about the ESCO business (ESCO 4, 2013). The 3.1 Inexperienced banking industries is a barrier that is no longer valid for big ESCOs, however it is still a problem for smaller companies in the ES market, see chapter 10.4.1 on page 109.

Technology barriers

Yang et al (2004) concludes that a large number of ESCOs in the PRC are not specialized in a certain field of EE and lack understanding of existing technologies. ESCO 1 (2013) agrees with the low specialization. However, other interviewees state that it is common that the ESCOs only offer few products that they are specialized in (Academic 1, 2 & 4, 2013). This in turn means that the ESCOs do not have the capability to do larger, more advanced projects which is a more accurate barrier than 4.1 ESCOs lack understanding of existing technology (see barrier 4.5 ESCOs lack understanding of ES system in buildings).

10.2.3 New barriers
New barriers were found in the interviews. Some of them are modifications on barriers found in the literature, while others are entirely novel findings.

Market barriers

In the literature it was found that clients’ lack of technological understanding caused problematic trust issues. Through the interviews, it became evident that lack of technical understanding decreased the buyer’s competence to such low level where they became unable to identify what measures to take or who to hire in order to improve EE (Academic 1, 3 & 4; ESCO 4 & 5, 2013). The barrier is be supported by the finding from the qualitative study, which found a significant correlation between commercial real estate developers knowledge level of ES and their investment frequency in ES (H₄). Hence, lacking technological understanding among clients can be referred to a lack of ES knowledge. Based on this barrier 1.6 Reduced buyer’s competence due to lack of technological understanding is introduced.

EE is not prioritized for developers or owners. The quantitative study found EE investments to be significantly less prioritized than other measures among commercial real estate developers in Shanghai (H₁). Instead, other actions are taken to increase the value of the property and rental premise, rather than spending the same money on reducing the energy costs over the long term (Academic 4; Architect 2; Developer; ESCO 2 &3; Investor, 2013). As the owners of the building only have a limited amount of money to spend, they invest it on the most profitable project typically not ES, which leads to the introduction of 1.7 EE investments have low priority.

Communication and information flow among the actors in the ES market is weak and it is hard for ESCOs to approach a new client without the appropriate connections within the client firm. Normally, it is the ESCO that approaches the client, if they cannot do this, it would be impossible to sell projects (Academic 1, 2, 3 & 4; Architect 1, 2013). There are online platforms
being developed by private companies (Architect 1, 2013) to make it easier for the ES actors to do business, but the barrier is still evident on the market: 1.8 Hard to approach and communicate with actors on the ES market.

**Institutional barriers**

Companies in the PRC tend to have low margins, especially in the industry sector. This in turn is holding back stricter building regulations from the government that could have encouraged more EE measures in buildings (Investor, 2013) which leads to the introduction of 2.5 Clients’ low margins holds back stricter regulations.

**Technological barriers**

Instead of the existing barrier 4.1 ESCOs lack understanding of existing technology that was found to be invalid in the chapter Technology barriers, a new barrier is proposed: 4.5 ESCOs lack understanding of the whole ES in buildings. As many of the smaller and medium sized ESCOs only offer a limited amount of products, there is a lack of ESCOs offering ES able to acknowledge for the complete system in a building. Also, they focus more on installation and maintenance of the products, rather than operation and management (Academic 1; Architect 1, 2013). The importance of this barrier was confirmed in the quantitative study ($H_5$) which showed that commercial real estate developer view the ability of the ESCO to offer a complete system solution for the buildings energy system as important for them to invest in ES.

**10.2.4 Barriers not confirmed**

Some of the barriers in the literature could not be rejected nor confirmed since they were not mentioned through the interviews. 2.2 SOE employees do not have incentives to invest in ES is a barrier that was not discussed in the interviews and consequently there is nothing talking either for or against it.
Table 37 Typical barriers in the ESCO market in Sweden and in Shanghai according to the literature, interviews and survey

<table>
<thead>
<tr>
<th>Category</th>
<th>Typical barrier</th>
<th>LIT</th>
<th>INT</th>
<th>SUR</th>
<th>SWE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Market barriers</strong></td>
<td>1.1 Poor energy pricing</td>
<td>X</td>
<td>D.12</td>
<td>H2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.2 Low awareness and lack of information</td>
<td>X</td>
<td>R</td>
<td>R(H4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.3 Hard to convince clients about the potential of ES</td>
<td>X</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.4 Client distrust due to lack of tech. understanding</td>
<td>X</td>
<td>A.1:A.2</td>
<td>H4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.5 Clients break their contracts</td>
<td>X</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.6 Low buyer’s comp. due to lack of tech. understanding</td>
<td></td>
<td>A.1</td>
<td>H4</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>1.7 EE investments have low priority among owners</td>
<td></td>
<td>D.4</td>
<td>H1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.8 Hard to approach and communicate with ES actors</td>
<td></td>
<td>E.1:E.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.9 Lack of marketing strategies</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.10 Low number of actors</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Institutional barriers</strong></td>
<td>2.1 Laws and policies regulating SOE activity</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.2 SOE employees do not have incentives to invest in ES</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.3 Hard to evaluate effects of ES due to lack of standards</td>
<td>X</td>
<td>B.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.4 Inadequate contract procedures</td>
<td>X</td>
<td>B.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.5 Clients’ low margins hold back stricter regulations</td>
<td></td>
<td>D.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.6 Unclear accounting principles for ES</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Financial barriers</strong></td>
<td>3.1 Inexperienced banking industry</td>
<td>X</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.2 Hard to value projects</td>
<td>X</td>
<td>B.1</td>
<td>OF</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.3 High up-front costs</td>
<td>X</td>
<td>B.3:B.7</td>
<td>H6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.4 Client has short term investment horizon</td>
<td>X</td>
<td>B.2</td>
<td>H3</td>
<td>X</td>
</tr>
<tr>
<td><strong>Technology barriers</strong></td>
<td>4.1 ESCOs lack understanding of existing technology</td>
<td>X</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.2 Lack of affordable energy efficiency technology</td>
<td></td>
<td>D.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.3 ESCOs lack qualified professionals</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.4 Hard for customers to evaluate ESCO products</td>
<td></td>
<td>A.1:E.1</td>
<td>H4:H7</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>4.5 ESCOs lack understanding of ES system in buildings</td>
<td></td>
<td>A.6:A.7</td>
<td>H5</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**: Red color = Invalid barrier according to interviews and/or survey, marked with R. OF = Other Findings, see chapter 9.6. LIT = Literature Study, INT = Interviews, SUR = Survey, SWE = Swedish barriers. The number code under INT derives from Table 14 and Table 15. References for the barriers found in LIT and SWE can be found in Table 10 ESCO barriers in the PRC with references Table 10 resp. Table 11

10.3 Comparison of barriers in the PRC and Sweden
To see how similar barriers in the Swedish ESCO market are compared to PRC, a comparison is made based on findings from both the literature and interviews.

10.3.1 Market barriers
In Sweden, clients do not have sufficient understanding of the technologies offered by ESCOs which in turn has affected the buyer’s competence in both markets. The same thing was found from the interviews in Shanghai. However, according to the survey, commercial real estate developers in Shanghai consider themselves in general to have at least a fair knowledge of ES.

In the PRC, marketing actions are being taken by the government in order to increase the awareness of ES which is steadily increasing even if it’s still low in less urbanized areas. In Shanghai the knowledge of ES is high among the actors and 1.9 *Lack of marketing strategies* is not considered a barrier. In Sweden on the other hand it is a problem with awareness of ES and there is a lack of understanding of business models similar to EPC.
There are not enough actors on the Swedish ES market. In the PRC, this problem is getting less significant as there are an increasing number of actors and the competition is growing. 1.10 Low number of actors is therefore only applicable to the Swedish market.

10.3.2 Institutional barriers
Laws and regulations for SOE in both Sweden and PRC are limiting ESCO activity. In Sweden this is mainly due to restrictions in municipal laws while in PRC the SOEs are limited because the state owns all the equipment.

Unclear accounting principles used to be a problem in the PRC to the extent where ES was close to be illegalized, however the government intervened and this is no longer a problem, or not considered a main barrier. 2.6 Unclear accounting principles for ES is still a main barrier in Sweden.

10.3.3 Financial barriers
The payback time is an issue in Sweden as well as in the PRC. Companies do not wish to have a longer payback period than 10 years, compared to the 3.5 years in the PRC. Much like the PRC, investors in the real estate sector do not understand why they should invest ES if the investments only benefit the next owner.

10.3.4 Technology barriers
Both in the PRC and Sweden ESCOs struggle to find personnel with sufficient understanding of all elements included in the ES business. In Sweden this derives from the lack of specialized university education. In the PRC, this is due to the fast expansion of the market and there are simply not enough qualified personnel for all new companies.

It is hard for clients to evaluate ESCO products. In Sweden this problem originates from the ESCOs marketing their products with their own brands resulting in hundreds of dissimilar services and technologies offered in the market, making it hard for the consumer to evaluate them.

10.4 Barriers to ESCOs in different stages
Based on the literature review and interviews, a list of barriers and challenges faced by ESCOs in four different stages is created. The different stages are newly established, growing, developed and international ESCOs. Many of the barriers mentioned earlier are applicable to all stages, such as the problem for clients to evaluate ESCOs, low awareness and the energy price. The barriers listed in this chapter are more or less significant as ESCOs mature.

10.4.1 Newly established ESCOs
With newly established ESCOs, ESCOs involved in entrepreneurial projects that do not have strong financial backing or renowned brands to help them are meant.

1. Lack of financial strength is one of the main problems as a new company only has limited registered capital and no credit record, which in turns makes it difficult to acquire loans from banks. Furthermore, $H_6$ shows that developers in the Shanghai market generally consider the ability of ESCOs to pay for the initial investment as
important when deciding to invest in ES.

Therefore, difficulties acquiring capital for smaller ESCOs become a large problem when their clients demand them to pay the initial investment. The government is trying to reduce this problem by introducing favorable tax rules and subsidies (Academic 1; ESCO 1 & 2, 2013).

2. There is also a financial risk involved when initiating an EPC project. This mainly involves the risks taken by financing and implementing the energy saving projects. A failed project may be costly and lead bankruptcy. Small ESCOs may be unwilling to accept larger projects due to engineering risks and inadequate securities. (Academic 5, 2013)

3. The lack reputation and recognition of new ESCOs is also a problem. Even if the ESCO would have financial strength to wholly fund, or partially fund projects, it will be difficult to get clients to accept the project due to the lack of a track record (Academic 4 & 5; Architect 1 & 2; Investor, 2013). $H_7$ shows that developers in the Shanghai market consider it important for ESCOs to have a track record. Also, the expert panel agreed that this is one of the most essential points for all ESCOs, not just the newly established ones. This may also lead to trust issues as the client sometimes have to share sensitive information with this new, small and unheard of company.

The quantitative study showed that developers consider an increase in reputation resulting from the usage of ES as an even greater motive than decreasing the energy cost. A small unknown company would not carry the same recognition as a large well known ESCO.

4. Lack of capacities and quality is another problem that may occur for new and small ESCOs. They are not capable of executing all the involved tasks required in the EPC business, such as conducting energy auditing, making innovation plans, communication with the customer and supplying the right type of technologies. (Yang et al, 2004; Academic 1, 2 & 4, 2013)

$H_5$ also found that developers in the Shanghai market consider it important for the ESCO to have the ability to offer a complete energy solution in their ES. Furthermore, the quantitative study showed that developers considered several measures such as building quality as a stronger motive for using ES compared to EE. Therefore, a small ESCO which cannot offer as good quality as established ESCOs will be at a disadvantage.

5. Bad business model may be a problem for ESCOs that do not derive from bigger enterprises, such as energy technology producers. These ESCOs often have little experience of the market and have an unclear market segmentation strategy. (Academic 2, 2013)
10.4.2 Growing ESCOs
For growing ESCOs, most of the problems include on how to keep up against competition and how to cope with market changes.

1. As a majority of ESCOs focus on non-residential energy savings, they are sensitive to the economic climate. This is especially true to companies focusing on certain industries where the demand fluctuates fast. (ESCO 2, 2013)

2. Due to the long payback time of ES, it is hard for ESCOs to continuously finance an increasing number of projects as they are growing. Banks are reluctant to grant more loans until the present loans are repaid. (World Bank, 2008)

3. As the ESCO industry has been booming during the past few years, there has become a shortage of professionals who can meet the expectations of the industry. The lack of these professionals is another factor preventing the development of a growing ESCO. (Yang et al, 2004; IBE, 2012)

10.4.3 Developed ESCOs
There are a number of factors preventing matured ESCOs from further expansion:

1. The policies and laws are not yet perfect. There are no compulsory standards which is preventing the development of matured ESCOs. However, according to the interviews there seem to be many compulsory regulations coming in the next few years, perhaps even in the next FYP. (Academic 1; ESCO 1 & 3, 2013)

10.4.4 International ESCOs
International ESCOs trying to enter the PRC-market will face a number of challenges:

1. When entering the market in PRC, it is vital to have contacts within the field. Unless the company has a strong and well renowned brand on the market, the lack of contacts will lead to failure in getting projects and thus fail to penetrate the market. (Academic 1, 2, 3 & 4; Architect 1, 2013)

2. The clients may have heard of ESCOs and EPC, and may even have used to services before. If the international companies’ services differ from what is the norm there is a risk that they will not understand this service and why they should chose it instead of what they have seen work before. (Academic 4, 2013)

3. The ESCO market is new, but there are already a rising number of established competitors on the market (Academic 4; Developer; ESCO 4 & 5, 2013). As with many other business, the first mover advantage is lost if establishment is not made early. Especially in a market that is evolving as rapidly as the Shanghai market.

4. To develop as an ESCO on the increasingly competitive ES market in Shanghai it is important to know about local policies and regulations, or the company will be at a
10.5 ESCO opportunities

Several barriers preventing ESCOs to succeed on the market have been found and presented. Some of these barriers can also be potential opportunities for the right type of company. More opportunities can be found throughout the quantitative and qualitative result section. This chapter is dedicated to summarize the main opportunities ESCOs have in the Shanghai ES market.

Throughout the interviews, it was stated that the potential for ES in Shanghai is great. The same conclusions can be drawn from the literature where more than 80 percent of the companies in PRC have plans of increasing their investment in EE and renewable energy, almost twice as much compared to levels in the western parts of the world.

The expansion of the ES can also be witnessed by the increased investments in EPC in Shanghai. Investment in EPC rose from 19.5 billion RMB in 2009 to 41.2 billion RMB in 2011, an increase of more than 110 percent.

With continuous government support through financial subsidies and implementation of favorable tax policies, together with support policies from local governments and financial products from commercial banks, the future markets looks promising for ESCOs in the PRC.

10.5.1 Communication (OP 1.1)

It can be hard for ESCOs to get into contact with other actors, it has become evident that communication is vital in order to sell ES. From the quantitative study ($H_4$) a significant correlation was found between the knowledge level of ES among developers and there investment frequency in ES. It became evident that the more potential clients know about ES, the more likely are they to invest. It is therefore important for ESCOs to be seen on fairs and to have a focus on marketing in order to increase the awareness and technical knowledge of potential clients. When working with clients it is important to educate the clients about the ES the ESCO has to offer.

Pilot projects (OP 1.2)

The importance of pilot projects was expressed throughout the interviews and later confirmed as an essential driver on the ESCO market by the expert panel. The quantitative study ($H_7$) also confirmed that commercial real estate developers in Shanghai view the existence of pilot projects among the ESCO as an important factor when investing in ES.

The problem derives from trust issues as the client may not believe that the ESCO is capable of delivering what is promised. Banks are also more likely to lend funds for the ESCOs projects. Potential clients may experience a lower degree of risk involved in the ES offered by the ESCO when successful pilot projects or a good track record can be demonstrated. This is especially important when a client is presented with a never before seen ES product.
10.5.2 Differentiate from other ESCOs (OP 2.1)

The interview study showed that the ESCOs operating in the Shanghai ES market has a low level of differentiation. The ESCOs are offering similar services and many of them only offer one or two ESs which occasionally are related to the physical products they are selling. The low level of differentiation leaves opportunities to offer new types of ES such as different forms of EPC or more complete ES, covering all aspects of a building or include education of FM as part of the service. It is also important for the ESCO to be involved in the operation of the building in order to ensure that the energy system is operated efficiently.

*Offer more comprehensive ES (OP 2.2)*

Offering a more complete ES is not only an opportunity because of the low level of differentiation. Throughout the interviews it was found that a large number of the ESCOs were of small or medium size and did not have knowledge or capabilities to fulfill all parts of ES pre-studies, implementation and maintenance. The qualitative study ($H_5$) also found that commercial real estate developers in Shanghai find it important that the ESCO is able to offer a complete energy system solution when investing in ES. A company that could do this would have an advantage over other ESCOs.

By offering a more complete system the integration, maintenance and daily operation of new technologies is ensured, thus reducing the energy usage even more. This was also considered as one of the most important factors by the expert panel.

*Offer short term ES (OP 2.3)*

The barrier of companies’ short term investment horizon in Shanghai leaves opportunities for small ES with a shorter payback time. E.g. as the owners and FM lack knowledge of technology, small adjustments to optimize the existing system can be made in order to reduce the energy usage. This would be a relatively easy and cheap type of ES to implement and the investment would be offset within the 3-5 year period that is the normal investment period for buildings in Shanghai. The normal EPCs are at least 6-7 years and up to 15 years which is far too long and client would rather spend their money on other, faster and more profitable investments. From the quantitative study a significant correlation was found between the investment horizon and the commercial real estate developer’s investment in ES in Shanghai ($H_3$). This may suggest that few ES are able to meet the short payback time required by the investors with a short investment horizon.

Offering services without a contracted time could also be a possibility. A service like energy co-operation would then be a great possibility as it does not have a long contracted time span. The clients could then reach their energy saving targets and make a profit in the process.

*Educating FM (OP 2.4)*

The quantitative study gave support ($H_9$) that commercial real estate developers view the FM understanding of the buildings energy system in terms of operation, maintenance and technical aspects to be important. This suggests that an ESCO would have a good outlook to convince clients of improvements in the FM area.
As of now, FM often has low knowledge of a facility’s energy system resulting in poor operation regarding the EE, leading to unnecessarily high energy usage and costs. As the influence of FM for the building’s energy performance is often neglected in ES, this can be considered an opportunity. By educating and guiding the FM, savings can be made without larger investments in new products. Improvement in the building’s EE can be achieved quickly and be long withstanding with proper training of FM personnel.

Add extra value for the client (OP 2.5)

The quantitative study showed that in general commercial real estate developers in Shanghai have other motives for investing in ES apart from lowering the energy cost of the building. Raising the reputation of the developer’s property, improving the quality of the building and increasing the rental premise are considered as a stronger motive than achieving lower energy cost. Being able to deliver these outcomes from the usage of ES would give the ESCO a clear advantage in the market. Especially as the quantitative study ($H_1$) found that commercial real estate developers in Shanghai consider EE as a low priority investment.

10.5.3 Increasing number of regulations, policies and subsidies (OP 3.1)

It was found through the literature study that existing policy for the ES market in the PRC was ranked the third most important driver for investments in EE. The PRC was the only country even to rank existing policy as driver, indicating that the PRC are getting stricter with their environmental targets. From the interviews and the expert panel, it was asserted that existing policies and regulation directed to the ES market in Shanghai greatly affect the development of the ES. Some ESCOs even expressed that 50 percent of their projects would disappear if existing subsidies in the market were to be removed. Others saw it as a competitive advantage for its company to have close ties to the central and local governments, enabling them to predict future policies and regulations designated for the ES market.

The quantitative study found that commercial real estate developer in Shanghai view policies and regulations supporting the ES as important when investing in ES. The Shanghai government has historically been one step ahead of the central government when it comes to issuing subsidies, stricter policies and regulations concerning EE. This is partly because well developed areas such as Shanghai has higher reduction targets in the FYPs compared to other regions, but also due to heavy pollution and increased problems with bad air quality which has forced the local government to act. E.g. funds in the Shanghai area can be up to ten times higher compared to those in the western regions of PRC.

GBL are growing more popular and may soon be compulsory (OP 3.2)

Green building certifications are partly negatively associated with increased building cost. However, there are also long term benefits if done right. The in-door climate is better and some tenants demand a green building standard for their premises. Also, there are both local and national governmental subsidies given for the Three star system, financing large parts of the investment costs. The subsidies drive the demand for the Three star system making them increasingly popular.
The green building certification market is something relatively new in the PRC, but it is growing rapidly. There have been discussions whether the GBL in the PRC is going to get mandatory. Would this be the case, the market would increase significantly, benefitting the ESCOs. As of now, the developers aim for the minimum standard unless something else is required.

**Increased price of energy (OP 3.3)**

The government in the PRC is strictly controlling the price of electricity. Without a regulated energy price, the industry would have serious problems as they are already working with low margins. If the price of energy would rise, either due to reduced regulatory control or by taxes, the potential for ES would rise. However, as of now, this is not an option for the PRC. In a few years though, due to the rapid change in the economic climate in PRC, it may become viable.

**High energy intensity (OP 3.4)**

The PRC has high energy intensity, meaning that a lot of energy is used for every unit of economic output. Compared to Sweden, the energy intensity in the PRC is 4.7 times as high. It is more than twice as high as Taiwan, which has a similar climate to Shanghai, and 5.6 times higher compared to the energy intensity in Japan.

In order to lower the country’s energy intensity, PRC issues strict regulations in the FYPs. The regulations are even stricter in urbanized areas on the east coast, such as Shanghai. Consequently, opportunities are created for ESCOs as they are playing a significant part in lowering the energy usage in non-residential buildings.

**10.5.4 Fast growth of Shanghai (OP 4.1)**

The floor space area of non-residential buildings has grown with over 200 percent since year 2000 and has kept increasing with 9 percent per year on average. In 2009 the signed building contracts was close to 450 billion RMB. This means that many new building constructions are underway where ES may be incorporated, increasing the market potential for ES, especially when considering the stricter building regulations and trend to certify buildings according to Three Star GBL.

**Increased living standards in Shanghai (OP 4.2)**

The GDP of PRC is increasing in a fast pace. A higher GDP generally means that a country is doing well and that the population’s living standard is increasing. Better standard of living leads to higher demand on indoor climate such as heating and air conditioning, which both increase the usage of energy. However, from the interviews and literature it was found that currently, people in general do not demand a high level of thermal comfort, heating, ventilation and AC would seldom be used even if was assessable in the building.

The fast economic development in Shanghai indicates that the living standard is rising. To be able to meet the challenging energy reduction goals, ES will be needed in buildings.
10.5.5 Financial assets (OP 5.1)
Numerous financial barriers have previously been listed. The interviews pointed out the importance of the ESCOs cover major areas or even all of the cost related to ES for the client. The quantitative study ($H_6$) further support to this notion and showed that commercial real estate developers in Shanghai generally view the ability of an ESCO to pay for the initial investment as important for them to invest in ES. If a company would have strong economic backing, this would not be an issue. Larger multinational companies often do not have problem financing the ES in a building, thus they have would have an advantage.

From the qualitative study, it became evident that smaller companies did not have the financial or operational capacities to accept larger projects. Apart from the financial strengths, larger companies normally also have a greater intellectual property.

Table 38 Opportunities for ESCOs in Shanghai found in the literature, through interviews and surveys. The number code under Interview derives from Table 14 and Table 15. LIT = Literature Study, INT = Interviews, SUR = Survey

<table>
<thead>
<tr>
<th>Opportunity</th>
<th>LIT</th>
<th>INT</th>
<th>SUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>OP 1.1 Communication</td>
<td></td>
<td></td>
<td>H4</td>
</tr>
<tr>
<td>OP 1.2 Pilot projects</td>
<td></td>
<td>E.3</td>
<td>H7</td>
</tr>
<tr>
<td><strong>OP 2.1 Differentiate from other ESCOs</strong></td>
<td></td>
<td>A.4;A.8</td>
<td></td>
</tr>
<tr>
<td>OP 2.2 Offer more comprehensive ES</td>
<td></td>
<td>A.7</td>
<td>H5;H1;OF</td>
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<tr>
<td>OP 2.3 Offer short term ES</td>
<td></td>
<td>B.2</td>
<td>H3</td>
</tr>
<tr>
<td>OP 2.4 Educating FM</td>
<td></td>
<td>A.5</td>
<td>H9</td>
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<tr>
<td>OP 2.5 Add extra value for clients</td>
<td></td>
<td></td>
<td>H1;OF</td>
</tr>
<tr>
<td><strong>OP 3.1 Increasing number of policies and subsidies</strong></td>
<td>4.10</td>
<td>C.1;C.2</td>
<td>H8</td>
</tr>
<tr>
<td>OP 3.2 Green building certifications may soon be compulsory</td>
<td></td>
<td>D.13;D.14</td>
<td></td>
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<tr>
<td>OP 3.3 Increased price of energy</td>
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<td>D.8;D12</td>
<td>H2</td>
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<tr>
<td>OP 3.4 High energy intensity</td>
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<td>4.4</td>
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<tr>
<td><strong>OP 4.1 Fast growth of Shanghai</strong></td>
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<tr>
<td>OP 4.2 Increased living standards in Shanghai</td>
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<td>D.8</td>
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10.6 Answer to reasearch problem
This study has thoroughly reviewed the market and barriers existing in the ES market in Shanghai as well as opportunities. Several barriers exist on the market. However, the majority of them are possible for an ESCO to overcome given time, resources and a sound strategy. Most of the ESCOs in the Shanghai ES market are small or medium sized enterprises. For them, many of the barriers become more severe compared to a large and established ESCO. Financial barrier such as 3.2 & 3.3, market barriers 1.4 & 1.8, institutional barrier 2.4 and technology
barrier 4.2, 4.4 and 4.5 are examples of barriers that would have less impact on a large and established ESCO.

Other barriers such as 2.1 & 2.3 cannot be overcome by the skill or maturity of an ESCO. However, these barriers could be removed from the market by government efforts. Therefore it is likely that these barriers will remain significant barriers in the Shanghai ES market until the government act to remove them.

Finally some barriers are considered as fixed barriers, barriers that cannot easily be removed by ESCO or government effort. This includes poor energy pricing (1.1), low priority of EE investment among owners (1.7), low margin among Chinese companies holding back stricter regulations (2.5) and short term investment horizon for building owners (3.4).

In conclusion, the maturity level of the ES market in Shanghai with a large amount of small and inexperienced ESCOs cause the majority of the barriers to have a severe impact to the use of ES in Shanghai. Together with the fixed barriers the maturity level is hindering currently available ES in the Shanghai commercial real estate sector from being used more frequently. In the future, when ESCOs have reached a higher maturity level, ESs will likely be used more frequently. The transition is probable to be driven by the many opportunities existing in today’s ES market in Shanghai.

10.7 Conducting research in Shanghai

When conducting the quantitative study, several difficulties were encountered which were hard and sometimes impossible to overcome. It seems no matter how thoroughly the non-probabilistic survey research was prepared, local contingencies to the Shanghai market made the study extremely time consuming and unpredictable. Several lessons learned can be drawn from the research execution of this thesis. Knowledge that hopefully could assist similar research conducted in the future.

Acquiring data such as lists of companies in different sectors from institutions, e.g. the Statistical Bureau of China was seldom possible, even though the information is supposed to be assessable to everyone. Explanations would often be that they are not allowed to give out data freely to anyone i.e. you had to be someone with connections.

It was virtually impossible to establish contact with relevant personnel within companies. Literally hundreds of hours were spent on this, trying various methods suggested by the literature, with poor result. When calling companies, the operator would hang up, ask for names of the person or suggest sending an email to a generic address. When emailing them, no answer was ever given. It was as if they did not have the authority to give out any information about a company member even less a senior person.

The severe problems faced when struggling to establish contacts with companies may reflect the general situation in the PRC and Shanghai. In order to get in contact with a person in the right position within the company, there was a need to know the person’s name or telephone number.
Connections are ever so important when conducting business in Shanghai. By conducting business with a known person, trust may already have been established. Without connections, it is also highly probable that the qualitative part of this study would have suffered. Knowing the right persons is always an advantage, but in Shanghai it became even more evident.

The contact establishment issues can further be related to the communication barriers. The lack of communication among the relevant actors has been identified as one of the main barriers. With the difficulties the researchers encountered, that barrier can undeniably be confirmed.

Whether conducting business or research in Shanghai and the PRC one should put considerable resources to identify and establish contacts in the relevant market.

10.8 Limitations & suggestions for future research

Our results have been able to elucidate earlier unexplored barriers and opportunities within the ESCO market in Shanghai. However, there are still areas which could be further studied.

The qualitative study was limited by the number of interviews. Saturated results were possible to attain from the most important actors, i.e. ESCOs and Academics. A saturated result was not received for the rest of the actors, and thus there is still a need for more interviews to saturate all of the results from the actors.

As the market and economic climate in Shanghai is rapidly changing and due to the expansion of the number of ESCOs and new policies, there will be a need to update the results found in this study in a near future. Much of what was found in older literature, even if it was only five years old, was shown to be invalid or not very important in today’s market situation. This is particularly true when it comes to barriers. Also, what will happen to the ES market if the growth continues with the current speed and with the increased amount of ESCOs?

An interesting and largely unexplored topic is the possible impact of a housing bubble in the Shanghai real estate market and the impact it would have on the ES market. In such an event the rapid expansion of new building construction in Shanghai may be halted and also wiping out a potential market for ES? On the other hand such an event may play in favor for longer investments in properties by reducing the occurrence of short investment horizon witnessed in today’s Shanghai real estate market? Instead efforts may be shifted to reducing the operating expenses of a building, among them the energy expenses, to improve the profit generated by a building.

In general higher energy cost as a result of using ES was a result from the quantitative study that deserves future investigation. Why the energy cost in general increase as a result of using ES in Shanghai is not given a definite answer in this study. However, it gives probable causes. For example the higher energy cost can be a consequence of raising the thermal comfort of a building as part of the ES. The ESCO may have been responsible for installation of previously non-existing HVAC systems. Or the ES may be used for attaining a GBL and not reducing the energy cost. The interview study showed cases of increased energy cost from implementation of GBL compared to buildings without a GBL. Furthermore, the higher energy cost may be related to theories explaining why energy efficiency may lead to a higher energy usage and
possibly higher energy cost. It would be interesting to further investigate if the higher energy cost from using ES can be limited to certain types of ES, when thermal comfort before and after the ES is considered and how it is affected by time i.e. the energy cost directly after the implementation of the ES and following a year or two.

This study has focused on the ES market in Shanghai. The city of Shanghai is special as it is a well-developed economic zone which tends to adopt regulations and changes ahead of other areas in the PRC. It would be interesting to compare the current ES market in Shanghai with other regions or cities in the PRC to see what differences may exist. This would help to create a complete picture of the ES markets in the PRC. An extension could be to compare the ES market in Shanghai to the different stages matured ES markets have gone through, which may give an indication of where the Shanghai ES market is going.

Because of the problems faced throughout the execution of the quantitative study, only a 52.5 percent response rate was achieved in the questionnaire. Furthermore, it was not possible to make a thorough investigation into the group of non-respondents whether or not they meant a source of bias. Even if most of the results were statistically confirmed, there would still be of interest to see whether the outcomes would have been the same with a higher response ratio.

This study has just scratched on the surface of the different barriers applying to small, large and international ESCOs. In order to get a more in-depth understanding, there is still more researching needed to be conducted within this field.
INTRODUCTION


LITERATURE REVIEW

Scientific publications:


Poole, AD, Stoner, TH 2003, Alternative financing models for energy efficiency performance contracting, USAID Brazilian Clean and Efficient Energy Program (BCEEP), administered by Winrock International.


Publication accessible through web


Webpages:


**METHOD**

**Books:**


**Scientific publications:**


O'Reilly, M & Parker, N 2013, ‘'Unsatisfactory saturation’: a critical exploration of the notion of saturated sample sizes in qualitative research’, Qualitative Research, vol. 13, no. 2, April, pp. 190-197 (online SAGE).

Peng, GC & Nunes MB 2008, 'Issues and difficulties in doing participative research in China: lessons learned from a survey in information system research', paper presented at the 7th European Conference on Research Methodology for Business and Management Studies,
London UK, 19-20 June 2008, pp. 245-252 (online Social Science Research Network (SSRN)).


Interviews:

**Professor Per Lunqvist**, Energy Technology, Royal Institute of Technology, Stockholm, meeting on 2013-04-02

**Mikael Ahlström**, ÅF-Infrastructure, Stockholm, interviewed on 2013-03-20

**Academic 1**: Professor, International Institute of Refrigeration, Tongji University Shanghai, interviewed on 2013-04-07

**Academic 2**: Associate Professor, Building Technologies, Sino-German College of Applied Sciences, Tongji University Shanghai, interviewed on 2013-04-07

**Academic 3**: Ph. D & Assistant Professor, Environment Engineering, Fudan University Shanghai, interviewed on 2013-04-08

**Academic 4**: Professor & Doctor, School of Mechanical Engineering, Department of HVAC and Thermal Engineering, Tongji University Shanghai, interviewed on 2013-04-09

**Academic 5**: Doctor, College of Mechanical Engineering, Tongji University Shanghai, interviewed in Chinese on 2013-04-22

**Architect 1**: Principal & Chief Designer, Architect Company, Shanghai, interviewed on 2013-04-17

**Architect 2**: Owner, Architect Company, Shanghai, interviewed through email on 2013-04-22
**Developer:** Senior Manager, Lease and Property Service Company, Shanghai, interviewed on 2013-04-10

**ESCO 1:** Project Manager, State owned ESCO, Shanghai, interviewed in Chinese on 2013-04-12

**ESCO 2:** Ph. D. & Senior Consultant, ESCO, Shanghai, interviewed on 2013-04-15

**ESCO 3:** Principal Consultant, ESCO, Shanghai, interviewed on 2013-04-15

**ESCO 4:** Ph. D & Principal, ESCO, Shanghai, interviewed in Chinese on 2013-04-16

**ESCO 5:** Engineer & Senior Consultant, ESCO, Shanghai, interviewed in Chinese on 2013-04-16

**Investor:** Assistant Manager, Investment Company, Shanghai, interviewed on 2013-04-19
## Appendix A  ESCO LIST BY NDRC

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<td>太阳能热水器，太阳能热水系统，太阳能热水系统</td>
<td>南昌市青云谱区阳明路8号</td>
<td>0791-88888888</td>
</tr>
<tr>
<td>217</td>
<td>江西恒新能源科技有限公司</td>
<td>太阳能热水器，太阳能热水系统，太阳能热水系统</td>
<td>南昌市青云谱区阳明路8号</td>
<td>0791-88888888</td>
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<tr>
<td>218</td>
<td>南昌市新能科技有限公司</td>
<td>太阳能热水器，太阳能热水系统，太阳能热水系统</td>
<td>南昌市青云谱区阳明路8号</td>
<td>0791-88888888</td>
</tr>
</tbody>
</table>
Interview Inquiry

Dear XX,

I received your contact details from XX. Currently me and a colleague are working on our Master Thesis that is supervised by two Professors from the department of Energy Technology at the School of Industrial Engineering and Management, Royal Institute of Technology. The Master Thesis is conducted in collaboration with a Major Swedish Technology Consultancy firm named ÅF. ÅF recently played a central role in the Wuxi Sino-Swedish ECO City project which was brought to attention by President Xi Jinping.

Our focus in the master thesis is the use of energy services in the Shanghai building sector. Where we are trying to answer the question:

Why does the demand for currently available energy services in the Shanghai building sector not reflect the benefits of implementing such services?

The study is sequential driven divided into two parts with a Qualitative/Quantitative approach. Right now we are working on the first part where a Qualitative study is underway. Therefore we are seeking Academics specializing in the field of energy technology and/or buildings as well as representatives from Energy Service Companies to interview regarding the use of energy services in Shanghai’s non-residential building sector.

Hearing what XXX had to say about your knowledge in the field, we like to ask you if it would be possible for me and my colleague to visit you at XXX for an interview sometime between the 9th-24th of April?

The interview would be around 25 minutes long, semi-constructed and recorded if that is okay with you. The interview can be conducted in either Chinese or English.

We would really appreciate if you would like to participate in this study. As a participant you will receive a small Swedish gift as a token of our appreciation.

Expert Panel Inquiry

Dear XX,

Again thank you for the interview opportunity. We have now analyzed the interview material from our three weeks stay in Shanghai. It would be wonderful if you would take a few minutes to answer a form with some multiple choice questions. The form will take around 5-7 minutes. It will help our research to validate our results and give a base for the next phase of our study.

Expert Panel Inquiry Reminder

Dear XX,

I kindly like to remind you of a short email survey (5-7 minutes long) that was sent to you around two weeks ago. We were worried that it might not have reached you? It would be superb if you could spare a few minutes to fill it in. Your expert feedback will help to validate our conclusions and give a much stronger result for our study.

Expert Panel Inquiry Final Reminder
Dear XX,

Do not miss the **Swedish Gift**, this is a final reminder to participate in the expert panel for the content validity form - Energy Services in Shanghai. The form will only take around **5 minutes to complete** and consist of **multiple choice questions**. It would be wonderful if you would take a few minutes to fill out the form. You will be able to see the result of the form after submission. Your expert feedback will help to validate our conclusions. All **participation in this study is anonymous**.

**Questionnaire Inquiry**

瑞典皇家理工学院（KTH）的对绿地建设节能服务的研究

尊敬的先生XX

您好

我们是来自瑞典皇家理工学院在中国的留学生，目前正在中国做一个毕业设计项目是"关于中国建筑耗能市场的前景调查"。

我们将由衷感谢如果您或者您贵公司里负责市场或者技术的主管可以抽空回答我们的一个在线调查问卷，以便我们得到毕业设计所需要的统计数据。

在您填写完问卷后，我们将给你邮寄出一个来自瑞典的小礼物作为答谢。

填写调查问卷，请点击此链接：[LINK]

非常感谢您抽空参与我们的问卷调查！

关于我们课题:

我，Mathias Melander, 和我的同学André De Geer是瑞典皇家理工学院（KTH）能源技术学院工程与管理专业的学生。我们的论文需要明确的问题是：“为什么在上海建筑行业目前可用的能源服务需求并不能反映实施这些服务的收益？”

如果您有任何进一步的问题，欢迎随时我们联系！

免责声明！

所有参与这项研究是匿名的。任何个人详细信息（如参与者的地址）只会被用以分发参与的礼品，并严格保密处理！
Appendix C  GIFT BAG

- Small bottle of Swedish snaps
- A piece of Swedish candy
- A pen
- A purse
- 1 gram of Saffron
- A recipe for saffron buns and saffron tea
## Operationalized Main Points

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The ability of Energy Service Companies to show profitable Pilot Projects or a Track Record of previous projects when approaching a Client is...</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Technical Knowledge of Developers, Architects, Tenants, Investors and Owners allows them to Identify the right measure for increasing the Energy Efficiency of a Property is...</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Two sided Communication and Information Flow between Energy Service Companies and Clients is...</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>For Market Actors to have Knowledge of Governmental Policies directed towards the Energy Service Market is...</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Having a high degree of Technical Competence in a Energy Service Company is...</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Having a high degree of Project Management Competence in a Energy Service Company is...</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>The Energy Service Company’s ability to offer the Client a Complete System Solution for a Building is...</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>The average time the Investors hold a position in a building is... for the Investors interest of investing in Energy Services</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Financial Incentives for the Tenant is... for their Demand of Energy Efficient Buildings</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Being able to Access Client Building Data for the Energy Service Company is...</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>The Energy Service Companies ability to offer Short Payback Time to their Clients is...</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>The Facility Management’s Technical Understanding, Operation and Maintenance of the Energy System in Buildings is...</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>In-House Facility Management operated by the Owners is...</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Prioritizing Energy Efficiency by Owners and Developers is...</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>During an Energy Service project it is... for the Energy Service Company to have adequate Legal and Financial Securities</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Relatively high Operating Expenses for Energy compared to the Total Revenue Generated from the Building is...</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>For Energy Services in the Future, Urbanization is an... driver</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>For Energy Services in the Future, Rising Wages is an... driver</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>For Energy Services in the Future, Inflation Costs is an... driver</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>For Energy Services in the Future, Electricity Prices is an... driver</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Existence of Standardized Contracts for Energy Services is...</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Having a high degree of Financial Capability in a Energy Service Company is...</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Asking whether the respondent agrees with the actor models (Fel! Hittar inte referenskälla. &amp; Fel! Hittar inte referenskälla.)</td>
<td></td>
</tr>
</tbody>
</table>
Content Validity Form - Energy Services in Shanghai

Dear Expert,

You have been carefully selected to be part of an expert panel evaluate the validity of preliminary findings collected from a Qualitative study of the Energy Service market in Shanghai. The study is aiming to give answer to the following research problem:

Why does the demand for currently available Energy Services in the Shanghai building sector not reflect the benefits of implementing such services?

In the following section 23 statements will be presented to you. For each statement you will have four multiple choices. Please read trough each statement carefully and take a moment to decide on your answer. You may only select one answer for each statement. If you are unsure about the meaning of a statement please check the “I do not know” button. After you have submitted your answers you will have no option to go back and change previous answers. To submit the form you have to answer each statement.

You are now ready to start compiling this form. Each participant will be sent a small Swedish gift as a token of appreciation after submission of the form. The results from the validity test will be possible to view after submission.

Good luck and thank you for your participation!

DISCLAIMER!
All participation in this study is anonymous. Any personal detail such as address to the participant will only be used to distribute the participation gift and handled confidentially.

* Required

1. The ability of Energy Service Companies to show profitable Pilot Projects or a Track Record of previous projects when approaching a Client is... *

   Please select the answer that best describe the importance of the statement for the Energy Service Market

   Mark only one oval.

   [ ] Essential
   [ ] Important but not Essential
   [ ] Not important
   [ ] I do not know
2. Technical Knowledge of Developers, Architects, Tenants, Investors and Owners allows them to identify the right measure for increasing the Energy Efficiency of a Property is... *
   Please select the answer that best describe the importance of the statement for the Energy Service Market.
   Mark only one oval.
   - Essential
   - Important but not Essential
   - Not important
   - I do not know

3. Two sided Communication and Information Flow between Energy Service Companies and Clients is... *
   Please select the answer that best describe the importance of the statement for the Energy Service Market.
   Mark only one oval.
   - Essential
   - Important but not Essential
   - Not important
   - I do not know

4. For Market Actors to have Knowledge of Governmental Policies directed towards the Energy Service Market is... *
   Please select the answer that best describe the importance of the statement for the Energy Service Market.
   Mark only one oval.
   - Essential
   - Important but not Essential
   - Not important
   - I do not know

5. Having a high degree of Technical Competence in a Energy Service Company is... *
   Please select the answer that best describe the importance of the statement for the Energy Service Market.
   Mark only one oval.
   - Essential
   - Important but not Essential
   - Not important
   - I do not know
6. Having a high degree of Project Management Competence in a Energy Service Company is... *
   Please select the answer that best describe the importance of the statement for the Energy Service Market.
   *Mark only one oval.*
   - Essential
   - Important but not Essential
   - Not important
   - I do not know

7. The Energy Service Company’s ability to offer the Client a Complete System Solution for a Building is... *
   Please select the answer that best describe the importance of the statement for the Energy Service Market.
   *Mark only one oval.*
   - Essential
   - Important but not Essential
   - Not important
   - I do not know

8. The average time the investors hold a position in a building is... for the investors interest of investing in Energy Services *
   Please select the answer that best describe the importance of the statement for the Energy Service Market.
   *Mark only one oval.*
   - Essential
   - Important but not Essential
   - Not important
   - I do not know

9. Financial Incentives for the Tenant is... for their Demand of Energy Efficient Buildings *
   Please select the answer that best describe the importance of the statement for the Energy Service Market.
   *Mark only one oval.*
   - Essential
   - Important but not Essential
   - Not important
   - I do not know
10. Being able to Access Client Building Data for the Energy Service Company is... *
   Please select the answer that best describe the importance of the statement for the Energy Service
   Market.
   Mark only one oval.
   [ ] Essential
   [ ] Important but not Essential
   [ ] Not important
   [ ] I do not know

11. The Energy Service Companies ability to offer Short Payback Time to their Clients is... *
    Please select the answer that best describe the importance of the statement for the Energy Service
    Market.
    Mark only one oval.
    [ ] Essential
    [ ] Important but not Essential
    [ ] Not important
    [ ] I do not know

12. The Facility Management’s Technical Understanding, Operation and Maintenance of the
    Energy System in Buildings is... *
    Please select the answer that best describe the importance of the statement for the Energy Service
    Market.
    Mark only one oval.
    [ ] Essential
    [ ] Important but not Essential
    [ ] Not important
    [ ] I do not know

13. In-House Facility Management operated by the Owners is... *
    Please select the answer that best describe the importance of the statement for the Energy Service
    Market.
    Mark only one oval.
    [ ] Essential
    [ ] Important but not Essential
    [ ] Not important
    [ ] I do not know
14. **Prioritizing Energy Efficiency by Owners and Developers is...**
   Please select the answer that best describe the importance of the statement for the Energy Service Market.
   Mark only one oval.
   - Essential
   - Important but not Essential
   - Not important
   - I do not know

15. **During an Energy Service project it is... for the Energy Service Company to have adequate Legal and Financial Securities**
   Please select the answer that best describe the importance of the statement for the Energy Service Market.
   Mark only one oval.
   - Essential
   - Important but not Essential
   - Not important
   - I do not know

16. **Relatively high Operating Expenses for Energy compared to the Total Revenue Generated from the Building is...**
   Please select the answer that best describe the importance of the statement for the Energy Service Market.
   Mark only one oval.
   - Essential
   - Important but not Essential
   - Not important
   - I do not know

17. **For Energy Services in the Future, Urbanization is an... driver**
   Please select the answer that best describe the importance of the statement for the Energy Service Market.
   Mark only one oval.
   - Essential
   - Important but not Essential
   - Not important
   - I do not know
18. For Energy Services in the Future, Rising Wages is an... driver *
Please select the answer that best describe the importance of the statement for the Energy Service Market.
Mark only one oval.
☐ Essential
☐ Important but not Essential
☐ Not important
☐ I do not know

19. For Energy Services in the Future, Inflation Costs is an... driver *
Please select the answer that best describe the importance of the statement for the Energy Service Market.
Mark only one oval.
☐ Essential
☐ Important but not Essential
☐ Not important
☐ I do not know

20. For Energy Services in the Future, Electricity Prices is an... driver *
Please select the answer that best describe the importance of the statement for the Energy Service Market.
Mark only one oval.
☐ Essential
☐ Important but not Essential
☐ Not important
☐ I do not know

21. Existence of Standardized Contracts for Energy Services is... *
Please select the answer that best describe the importance of the statement for the Energy Service Market.
Mark only one oval.
☐ Essential
☐ Important but not Essential
☐ Not important
☐ I do not know
22. **Having a high degree of Financial Capability in a Energy Service Company is...**  
   Please select the answer that best describe the importance of the statement for the Energy Service Market.  
   Mark only one oval.  
   - Essential  
   - Important but not Essential  
   - Not important  
   - I do not know

**Picture 1, Actor Map for Phases in a New Construction Project; Hover over the picture for explanation**

![Actor Map for Phases in a New Construction Project](image)

23. **Do you Agree to the Actor Map in Picture 1?**  
   Please give your answer in the text box below

   ![Response Text Box](image)

**Picture 2, Actor Map for Phases in a Retrofit Project; Hover over the picture for explanation**
24. **Do you Agree to the Actor Map in Picture 2?**

   Please give your answer in the text box below

   ........................................................................................................

   ........................................................................................................

   ........................................................................................................

   ........................................................................................................

   ........................................................................................................

25. **Respondent information**

   Please fill in your address if you wish to have a gift sent to you

   ........................................................................................................

   ........................................................................................................

   ........................................................................................................

   ........................................................................................................

   ........................................................................................................
Dear Expert,
You have been selected to be part of a survey evaluating the Energy Service market in Shanghai. The study is aiming to give an answer to the following research problem:

*Why does the demand for currently available Energy Services in the Shanghai building sector not reflect the benefits of implementing such services?*

**Definition of energy services (ES):**
Services related to energy usage aiming to increase the energy efficiency and/or energy conservation of energy usage. The services include direct and indirect energy services. Direct services cover services that give recommendations to pursue increased energy efficiency and/or energy conservation without participating in the implementation of the recommendations. Examples of indirect energy services are Energy Audits.

In the following section 12 questions will be presented to you. The questions consist of multiple choices, ranking or slider questions. Please read through each question carefully and take a moment to decide on your answer. If you are unsure about the meaning of a question please check the "I do not know" button. After you have submitted your answers you, will have no option to go back and change previous answers. To submit the form you have to answer each question.

You are now ready to start compiling this form. Each participant will be sent a small Swedisch gift as a token of appreciation after submission of the form.

Good luck and thank you for your participation!

**DISCLAIMER:**
All participation in this study is anonymous. Any personal detail such as address to the participant will only be used to distribute the participation gift and handled confidentially.

**Questionnaire**

*For how many years has your company been engaged in real estate development?*
Choose the answer that best describe your company

- [ ] Less than 3
- [ ] More than 3, less than 10
- [ ] More than 10

*What type(s) of Real Estate Development is your company engaged in?*
Choose the answer(s) that best describe your company

- [ ] Office
- [ ] Industry
- [ ] Retail
- [ ] Residential
- [ ] Government
- [ ] Other, Please specify

*How long is your company's typical investment horizon for properties?*
Use the slider below
Rank the following investment measures in a way that your company would prioritize them. 1 is most prioritized and 7 is least prioritized. You may only use each number once and all rows must be filled.

<table>
<thead>
<tr>
<th>Measure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air Quality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Amenities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal Comfort</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space Layout</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy Efficiency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building Material</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

How important is net profit and payback time for your company’s project(s)?
Choose the answer that best describes your company:

- Equally important
- Payback time is more important
- Net profit is more important

The operating expenses for energy compared to the total revenue generated from the building is not high enough to prioritize energy efficiency investments.
Choose the answer that best describes your company:

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

What level is your company’s knowledge of Energy Services?
Choose the answer that best describes your company:

<table>
<thead>
<tr>
<th>Very Poor</th>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Very Good</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

How important is it for your company that...

<table>
<thead>
<tr>
<th>Importance</th>
<th>Very Unimportant</th>
<th>Neither Important nor Unimportant</th>
<th>Very Important</th>
<th>Extremely Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Energy Service Company pays the initial investment of equipment?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Energy Service Company has a track record of profitable projects for you to accept a project?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Energy Service Company is less renowned than your company?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Government supports investments in Energy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Quantitative Questionnaire Putonghua

The Energy Service Company can offer a complete system for your decision to invest in Energy Services. The Facility Management has understanding of Operation, Maintenance and Technical aspects of the property's Energy System?

<table>
<thead>
<tr>
<th>How often does your company invest in Energy Services?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
</tr>
<tr>
<td><img src="image1.png" alt="Image" /></td>
</tr>
</tbody>
</table>

How important were the following motives for the use of Energy Services in your company in the past?
Choose the answer that best describe your situation.

<table>
<thead>
<tr>
<th>Motive</th>
<th>Not at all Important</th>
<th>Very Unimportant</th>
<th>Neither Important nor Unimportant</th>
<th>Very Important</th>
<th>Extremely Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Cost</td>
<td><img src="image6.png" alt="Image" /></td>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
<td><img src="image9.png" alt="Image" /></td>
<td><img src="image10.png" alt="Image" /></td>
</tr>
<tr>
<td>Subsidies</td>
<td><img src="image11.png" alt="Image" /></td>
<td><img src="image12.png" alt="Image" /></td>
<td><img src="image13.png" alt="Image" /></td>
<td><img src="image14.png" alt="Image" /></td>
<td><img src="image15.png" alt="Image" /></td>
</tr>
<tr>
<td>Increase Property Value</td>
<td><img src="image16.png" alt="Image" /></td>
<td><img src="image17.png" alt="Image" /></td>
<td><img src="image18.png" alt="Image" /></td>
<td><img src="image19.png" alt="Image" /></td>
<td><img src="image20.png" alt="Image" /></td>
</tr>
<tr>
<td>Quality</td>
<td><img src="image21.png" alt="Image" /></td>
<td><img src="image22.png" alt="Image" /></td>
<td><img src="image23.png" alt="Image" /></td>
<td><img src="image24.png" alt="Image" /></td>
<td><img src="image25.png" alt="Image" /></td>
</tr>
<tr>
<td>Increase Rental Premise</td>
<td><img src="image26.png" alt="Image" /></td>
<td><img src="image27.png" alt="Image" /></td>
<td><img src="image28.png" alt="Image" /></td>
<td><img src="image29.png" alt="Image" /></td>
<td><img src="image30.png" alt="Image" /></td>
</tr>
<tr>
<td>Reputation</td>
<td><img src="image31.png" alt="Image" /></td>
<td><img src="image32.png" alt="Image" /></td>
<td><img src="image33.png" alt="Image" /></td>
<td><img src="image34.png" alt="Image" /></td>
<td><img src="image35.png" alt="Image" /></td>
</tr>
</tbody>
</table>

What was the effect of using Energy Services in your company in the past?
Choose the answer that best describe your situation.

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Timing
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Basic Information

尊敬的专家，

我们荣幸地被选为上海节能服务市场的调查对象之一。这项研究旨在探究以下问题：
为什么要在上海建筑行业对新能源服务的需求不能反映其潜在的价值？

新能源服务（ES）的定义，
新能源服务是指在提高能源效率和减少能源消耗相关的服务。这些服务包括直接和间接的能源服务。间接服务是指那些影响提高能源效率和减少能源消耗的服务，例如管理能源服务的一个例子。

以下部分将依次涉及12个问题。这些问题包括多选题和单选题。请尽量详细回答每一个问题。如果您不确定有关的问题的含义，请勾选“我不知道”的选项。如果您提交的答案，您需要回去修改以前的答案。您必须回答所有问题才能完成表格。

感谢您在业余时间开始。
每个问题参与者都会被赠送一个来自深海的礼物，作为对您配合我们调查的答谢。

祝您好运，谢谢您的参与！

免责声明，
所有参与这项研究是匿名的。任何参与者个人的详细信息（如地址），仅仅作作分发参与者礼品之用，我们不会对您的信息进行处理。

Questionnaire

贵公司目前在房地产开发行业从业多久？
请选择最接近的答案
- 少于3年
- 3-5年
- 10年或以上
- 不知道

公司商务对象范围？
请选择最接近的答案
- 企业写字楼
- 工业生产
- 零售厂房
- 居民楼
- 政府办公大楼
- 其他（若有，请作详细说明）
- 不知道

贵公司的业务通常周期为？
请选择最接近的答案

0 2 4 6 8 10 12 14 16 18 20
请根据该公司的节能减排标准，对以下的投资对象排序。
1 为最高，7 为最低。每一行只能选择一个数字，并且必须填满所有行。

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在你公司的项目中，净利润与节能减排分别有多重要？
请选择最重要的一项答案。
〇 同等重要
〇 净利润更重要
〇 节能减排更重要
〇 不知道

“节能减排产生的直接收入相比经营费用不够高，所以一般不优先考虑对于节能减排的投资。”
请选择最接近的一项答案。

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你公司对节能减排的了解程度？
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对贵公司来说，...有多重要？

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贵公司是否引进能源服务的频率是？
请选择最接近的一项

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请注意各项对您公司的现在业绩产生的影响。

请选择最接近的一项

<table>
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请写下您公司的地址，以便我们送去小礼物。

Timing

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Appendix F  EMAIL STRUCTURE

The basic structure of the email was:

- A short expression of appreciation for the interview opportunity
- Inquire about the possibility of them to be part of the expert panel
- Inform of the importance of the questionnaire data
- Information about the estimated time to complete the questionnaire
- Encourage the respondent to complete the questionnaire and receive a gift
Appendix G  CONTACT PRIORITY

In decreasing order of importance contact information for quantitative sample was collected:

1. SP2 name
2. SP2 telephone number
3. SP2 email
4. Other personnel’s telephone number
5. Other personnel’s email
6. Reception telephone number
7. Reception email
8. Company webpage
Appendix H  TELEPHONE GUIDELINES

1. Present yourself and the researchers
2. Present the study (D3) and which contact is inquired (SP2)
   a. Name of senior person
   b. Telephone number to senior person
   c. Email to senior person
   d. Generic Email for inquires
3. Inform about the length of questionnaire (B3)
4. Inform about collaborators to the study (C3) & (D3)
5. Inform about anonymity for participants (C3)
6. Inform about the benefits attained for participants (A3)
   a. A small Swedish gift
   b. Ability to see the research results
## Appendix I  TABLES AND FIGURES

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Appendix J  INTERVIEW TRANSCRIPTS

Academic 1 & 2

Date: 2013-04-07

Interviewers: Mathias Melander & André De Geer

Interpreter: YES [ ] NO [ X ]

If YES name:

Language: English [ X ] Chinese [ ]

Total time: 58:17

Recording: YES [ X ] NO [ ]

What barriers exist for the development of energy services in the building sector in Shanghai?

AL: Dr. Rui just did a project for a similar topic, analyzing barriers for using energy technologies in Chinese buildings. First barrier is the lack of information knowledge and the people’s demand. Some people are not interested in building technologies. The second is the lack of financing for companies to take loans etc. The third is management and the operation of building performance. For the ESCO from my view, the biggest obstacle is the economical things. The first investment and the payback mechanism are not strong enough. Also, I think… I think the first thing is the energy price. PRC the government is strictly controlling the electricity price. If it is rising maybe everything may be rising. So they are seriously controlling the electricity price. But like natural gas they have no such control. Recently the natural gas price may go up quite rapidly. Like in heating, CHP or HVAC use the natural gas has no economic benefit so in some cases they do not like to do such projects. ESCO they have no income so it is a big problem. Secondly it is a problem for the company. Maybe for a foreign company is easier. For a local company they have to pay VAT, but for services no such VAT they should I think they should it is better that they pay sales tax it is more low then the VAT, so it is also a problem. The third thing is maybe now that for some government building government agency they can do some energy contracting management because they have some money from the local or central government, each year they have some money to be used for some energy efficiency project. But if you change the equipment of their system if you change the boiler, it cannot be moved from the government bills. If you change a boiler then they cannot change a boiler. They say that it is a state owned asset, it cannot be moved.

Does it mean that ESCOs cannot invest in government buildings?

AR: It is very hard they cannot change the large equipment like the chillers.
The start of the ESCO market in china started with three domestic companies.

AL: yes it is true; three companies got the loans from the World Bank.

Now it is around 1000 companies in the market but it seems that not many succeed even they say that the market potential is good. Can you elaborate on the problem for some ESCOs?

AL: I think for the foreign companies the district development is easier, they may need an energy plan or energy station. They need some investment. They need some professional knowledge. They need to complete the project. So maybe the foreign company can bring in money. They can invest in fully new equipment from the beginning of the project and operate it.

AR: the foreign company can invest and operate the equipment from the beginning of the project. They may even do retrofit. The energy users will pay the energy usage to them.

AL: Do you know the BOT or BOO model the build own and operate an invest model? Maybe I think it is better for the foreign companies. And for very professional company, they have the good money, the technology, and operation knowledge.

How is the knowledge of the local companies?

AL: Many local companies are very small and may have only one technology like Variable Speed or Variable Volume or change the pump. Now the rather bigger ESCO companies are also from foreign companies like, Johnson Control from the USA, also Carrier, a big manufacturer of chillers but they also do ES in buildings, Siemens just like… the business of energy service sector is still very small. Just like Siemens they almost cancelled their ES office in China because their revenue was too small.

How come their revenue is so poor?

AL: This was just an example. I know many communities that are developing the buildings. Many ES project all over China. So in the near future the outlook is very good for ESCOs.

Has the central government been encouraging the use of ES in buildings? How have this been done?

AL: Yes the governments have been focusing on this as a consequence of Chinas strained resources, especially the central government.

Can it be said that ES is more interesting to use in some sectors than others, for example the private or public sector?

AL: Three types of companies are most interested. Foreign worldwide companies. Also state owned large companies as the state owned gas or grid utility companies and big once.

CASE 1: Are the utility companies stretching out to the consumers giving ES?

AL: Yes this is very common in China. Like the state owned Gird Company.
CASE 2: Technology consultants relying on third party to give ES, does it exist in China?

AL: Yes this happens in China. These companies exist in China. Even used in large projects. A student of mine started one of these companies. These companies need to rely on the third part company.

CASE 3: Do ESCO companies evolve from within an existing company?

AL: Yes I think it is similar in China that this happens.

Is it common to have heating systems and the thermal comfort in buildings in Shanghai?

AR: In shanghai it is not so common. But in the Northern part of China district heating exist. It is different in different parts of China.

AL: Hotels have often internal standards for their energy use that they have to meet even if others do not exist.

What is the driver for energy efficiency in Hotels? Does it arrive from employees, regulations or other sources?

AL: Sometimes it is connected to the salary and the workers can earn more if the energy savings is good.

Are there any special characteristics for the Energy Usage in Shanghai Buildings?

AL: Often the AC is not used even if it is used or the ventilation is not on. The operating time is not that high in Shanghai and also fresh air is not that strict.

What impact can regulations have on the ES market? For example change in building standards?

AL: In the near future somebody said in 2017 around 2017 maybe the green building standard that is currently voluntary, green building standard may become mandatory. For green buildings China have our own 1, 2, 3 star rating. In maybe 5 years the 1 star will be mandatory for all buildings. And then this will affect the ES in buildings.

What sectors are more or less attractive for ES in buildings?

AL: Not residential buildings. In the residential buildings very little energy is consumed, for 100 families 200 units of AC but they are used very little maybe 600 hours per year including the cooling and heating. Nowadays more people are focusing on the indoor environment. For example floor heating or a small boiler for a family. More and more people are using this system. But they are paying maybe 1000 RMB per month for a 100 m² apartment for a family.
Date: 2013-04-08

Interviewers: Mathias Melander & André De Geer

Interpreter: YES [X] NO [   ]

If YES name: Jessie Liu, BA in Mathematical Economics, Fudan University
Language: English [ X ] Chinese [   ]
Total time: 30:13

Recording: YES [ ] NO [ X ]

**What are the barriers for implementing energy services in Shanghai?**

This is not really my field. However, from my personal experience building owners is the biggest barrier for energy services. The city plan is constantly changing. There are new parts of the town being built and it is impossible to predict the future. The owners may therefore be forced to remove their buildings, and long turn investment is therefore not an option.

**Do people in general know about energy services and the potential of efficient use of energy?**

No, people in general do not know about energy service and the potential of it. Single households do definitely not know about it.

**From where do the ESCOs come from?**

For example, there is a company in the ventilation business. They started selling ventilation services and developed into an ESCO doing all kind of energy services.

**Does the staff care about energy improvements?**

First of all, there are two layers of staff. The hotel staff in general does not care about energy efficiency improvement. They do not have the experience or knowledge. However, the management cares.

**How does the fixed energy price affect the market?**

It affects the market a lot; a rise in the energy price could cause chaos. If it for example rises one cent today, then what is the price going to be tomorrow? The uncertainty would affect the Chinese market badly.

**What do you think about the future energy market?**

The household standard will increase in the future and Smart Grid technology is a future technology
Is the existence of ESCOs market meaningful in the PRC?

Yes, I think it is very important for energy efficiency for buildings and for energy savings and environment protection. There are so many existing buildings in China, if there is no ESCO then the existing building cannot be developed so well.

Do you think the ESCOS in the Shanghai market are successful?

It is not successful in Shanghai. There are still many barriers. But in the past ten years, the market has developed a lot but there are still plenty of barriers. Actually, yesterday I was in Beijing and we had an internal seminar where we discussed the barriers of ESCOS. We think that there are two big problems:

The first one is the financing because most of the ESCO companies are small and it is therefore very difficult for them to borrow money from the bank. Only by contracting, they cannot borrow money. Even from other sources it is difficult. The reasons for this are very complex and it is not so easy to solve this problem.

Would it be better if the banks had better knowledge of what ESCOs do?

That would be helpful but might not be so helpful. For banks, money is first priority and they need to see how to get more money. They need to see that financing ESCOs is worth their money. So, this is the first problem, financing.

Another problem is how to evaluate energy saves from different projects. This is technology, on how to exactly calculate the energy savings, methodology. For buildings, I think, is more complex. The energy saves depends on different variables, for example the outdoor temperature and the occupancy density and other variables.

Do the customers understand this or is this something the ESCOS are trying to tell them?

The customer may not understand this, or they only know a little bit but they do not know exactly the variables that can influence. The ESCO therefore have to explain this to the customers, but the customer will not actually believe what the ESCO tell them. The government
should actually issue some standards. Yesterday we actually discussed on how to add some standards to evaluate energy saves to buildings.

**Do you think it is possible without standards to solve this problem? Maybe the company has some kind of approach where they are very clear in the beginning of the process.**

Actually, if the customer and the ESCO agree on one approach/methodology, it is no problem. Then they just write the contract. But sometimes they do not agree on and then there will be barriers and then the project cannot will go on. Then the standards are very important. There are already some international standards like IPNVP. This is international standard/guidelines like Ashree. But this may not be appropriate for the Chinese market because China/Shanghai has its own attributes. So China needs our own standard.

**Could you explain a little bit more about different in management?**

There are different types of management in the Shanghai market for example office buildings or commercial buildings. Some buildings are built up and invested by the owner and managed by the owner. But most of them are invested by the owner and rented out. There will be a facility management company managing this building. There are also some buildings invested by the owner and then sold out to many owners. There will then be many owners. In the kind of building it will be very hard to do retrofit because it will be hard to persuade every owner to agree even if energy savings would be very big. Retrofit project impact the operation of the building which needs to be considered.

I think in Shanghai, the management will be different types, and also very complex for different buildings. ESCO companies therefore have to know different types. They should also know different levels that can decide whether to invest or not.

**How about different energy service contracts, like energy audits and EPCs, are there other type of contracts that are normal?**

I think more and more buildings employ this kind of energy management contracting. Because, there are two reasons. One reason is that normally the owner don’t want to invest money on this and they want to use other companies to finance. I think also the risk can also give to ESCO company. Also, the other reason is that if this project is using EMC approach then they can apply to the government for some money. For now the government is issuing some kind of price for these projects.

**Is it different depending on what region you are in?**

There are some rules from government, and also Shanghai local government. This system is working fine and the government would issue some third party evaluation unit for example Tongji University and also teachers and students also join evaluation for some ESCO projects. According to tables and reports from ESCO companies we calculate and do some evaluation and we write a formal report and send it to the government. We evaluate the value of the energy saves made by the ESCO Company. Is it right or not? It is according to the actual condition or
not? Then government would give some money to the ESCO company according to the evaluation result.

**What standards do you use to evaluate the performance?**

Actually there are already two standards issued by the government. Normally we would use these two standards for China. If some projects are complex, because China standards there are still not very detail rules, then we will also base the evaluation on international standards like IPMVP, Ashree.

**We were wondering what kind of technology and services the ESCOs are using. Are they using many different kinds of technologies?**

In Shanghai there are, for different types of buildings, there are already have Retrofitting in the ESCO way, for example for hospitals, office and shopping malls, maybe schools. And also residential buildings. For office buildings the technologies for retrofitting also include the high efficiency lighting systems, like using LED lighting instead of tube lighting. Also for air conditioning system. For air conditioning the variable frequency drive technology is normally used for fans and the pumps. Also some companies are also developing some products for chiller plant automation.

For commercial buildings the number one is air conditioning then lighting system. Also for the lift, the escalator technology and also for the envelope for office buildings. Sometimes change the window glass or put film on the glass. For shopping mall also including lighting and air conditioning. For AC LC economizer used in Pudong with great energy savings.

**Do the ESCO normally have the ability to do all different technologies?**

Actually no. Normally, the ESCOs are very small and do not have this ability. They can only do variable frequency drive for the pumps, they are derivated from a company that sold variable frequency pumps. Or some companies have some special products, they can only do this one. More and more are trying to do all different types of retrofit technologies. Not just one or two technologies

**So, is that a trend that you start with one product, use that and then try to broaden?**

Yes. There are also some bigger companies that try to do all. But for these companies the competition is very big. It is good for the companies to have one product for themselves.

**The companies that are smaller, are the customers happy with their services?**

Actually, until now the market is for customer, not for ESCO company. There are more and more ESCO company and there are still many barriers. They want to get some project, actually I didn’t hear complain. I didn’t hear more complain from ESCO companies about barriers and difficulties. Actually, the complaint from customer are more on how to evaluate the energy saves.

**What happens when there is a disagreement?**
A: The customer might think that the energy saving is not from the energy saving retrofit technology but from climate variance.

**Who contacts, who? Is it the ESCO or the customer?**

Two way.

*Showing and explaining picture*

Shanghai is now in the process of more outsourcing than 10 years before. Before most management was inhouse.

**Do you think they are losing inhouse competence during this process?**

Uhm, I think, in my understanding that only some business are outsourcing. For example cleaning and management. I’m not very clear about this process. More outsourcing but the process is very slow. For ESCO services these services are mostly done by ESCO Companies.

**After an ESCO does a service, do they also build up some kind of competence for the customer?**

Ahh, ummm, ehh. Ehhh, mmm. Jaa. I think in the long run the competence of the customer will also be build up. At least the customer will be more aware of how to improve the energy efficient of the building. Some facility management like in the Jingmao tower used energy audits but did not complete the recommendations however their knowledge was increased.

**Is there any difference working in the ESCO market for foreign/local companies?**

The market is really big but I think for foreigner and overseas company it is even more difficult. Because sometimes it is really difficult for them to understand the local conditions here.
What is the potential for the energy service market in Shanghai?

Three main areas exist in this market, including industry, architecture and public transport. Each is 1/3 of the market. The energy saving market in particular for architecture/building service is developing rapidly. Construction services and energy consulting services are available but so far the energy products for this area is rare in China. China need to develop the management system and advanced and efficient products in the energy service industry.

Is the issue limited to the technology?

The first issue is maintenance and of the equipment, HVAC, and management of the buildings. Secondly is the energy products/equipment used in the buildings.

What is the difference between the western and Chinese ESCOs?

There are consultancy services in China but there is a huge gap in terms of technology between China and abroad, for example, the heat pumps, solar energy service etc.

Why are there no technologies from abroad that come into use in China?

Foreign companies like Siemens also do business in Chinese markets but according to recent regulations and govern regulated systems more local co operations are needed in this service. The biggest problem for energy service companies is not energy efficient products but for how to enter the market. For example the government plays a greater role in the process of energy services used for hospitals and schools.

What could the government do then?

Sorry, I have little knowledge of that.

Is it the knowledge or interest that inhibits the service?
In China, according to specific regulations, energy service companies cannot do whatever they want. They have to follow the regulations. And government officers usually get involved with energy service associations that give suggestions to the company.

**Which government administrations are involved?**

Shanghai economic and information committee for the industry. University academics or scholars for the supervision of energy saving. This is why the government policies are close connected to the market.

**Do ESCOs have to rely on the government to operate?**

No. But they have to get a good knowledge of the regulations and the market. Which is very regulated by the government.

**Do you know what is regulated?**

There was a time when the government tried to promote solar energy but the market crowded out in response most of the companies that rushed for business. In the beginning, those enterprises couldn’t survive without subsidies but in the end they went bankrupt due to it.

**When the government is involved, is it always a indirect or direct subsidy?**

Both exist, but direct ones are dominant, more appealing to the energy-saving companies.

**The problem with management and maintenance systems is it constrained to ESCOs or their clients?**

The behaviors of the tenants have been poor in regards to their energy use. They have not cared about turning of the ventilation or the lighting and this is a problem with the maintenance system of the buildings. Contracting maintenance system is usually implemented in hospitals or schools by energy-saving companies, but not in good shape.

**How do the ESCOs reach out to their clients?**

The ESCOs would reach out to their clients.

**What are the normal disputes in the contracts?**

Some of the measurements are not so well-termed in a contract that may lead to the contract. For example, client would argue that the company reduces their energy cost as well as productivity. This is a distinct problem in China

**How do they come to such a result of lower productivity?**

An excuse most of the time but there are also other times when they hardly reach consensus on the measurement of energy saving or standards. But sometimes the productivity is actually reduced.
This reduced productivity is it caused by the installation and the ESCO service or is it external?

It comes more from external factors such as slowdown in the industry.

What is the factor that causes such problems?

When they do business with large enterprises, the energy saving companies normally do little to better their service in case they would meddle up the complicated industrial procedures which they had little knowledge of. The ESCOs are not so technologically advanced so they might think twice before taking on complicated projects. However it is rare that the large clients with good credit rating would start a contractual conflict.

Does good reputation and size of the ESCO influence the willingness of contracting?

Not really. The services or the past experience in a certain market matter the most. Reputation is rated the second.

Does the energy service company get information from their clients or the other way around?

The energy service company would approach their clients first most of the time and offer basic information. But there are also other times when the clients know very well about the whole procedure in a certain industry, they would contact the company directly.

What do you think about the future of energy market?

The market is not bound to succeed even though there are huge market potentials due to economic growth and urbanization in China. Standardized regulations and government support, products, intellectuals, talent and maintenance systems are still unsatisfying to some extent for a healthy market to grow. But in general I’m very optimistic about the energy market in China.

*bubble pic*

This cycle also fits in Chinese market but there’s not yet either positive or negative feedbacks. For the time being, we are still trying to find a way out of energy consuming mode of production, that is, at the very elementary level of development.

Developers or architectural or construction companies that would need the energy service?

None of them. The owners (also the inhabitants) of the office buildings do.

AFTER INTERVIEWIES REFLECTION ON THE ES MARKET

I think for energy savings in ES there are more and more opp in china and the energy eff level I very low compared to us or Sweden. So we have opportunities. What we need is products, people regulations, experts or other related people in these ES field to be involved.
**What is the potential of Energy Services in Shanghai?**

I think it is more like a movement especially in China. In the last this is a big concept and every level of the government and the society get involved including the private sector and academics. I think sometimes we mix the concept with low carbon city with energy efficiency. What I can tell you is from the government and the ministry of housing and property. They are very powerful and restrict how to build the housing. They have issued much tougher regulations on how to build the offices and buildings and what material to use. It is very powerful tool to change the energy efficiency of buildings by issuing building codes. Also we have incentives policy’s from the government that give subsidies for projects especially pilot projects for energy efficiency. These projects can receive support from the government both the central government and local government.

**How does the shanghai governments policy differ from the central government?**

In shanghai the focus is on incentive policy. But I do not think it is a strong as the central government building code that is compulsory. They also encourage other sectors to reduce their energy use as the transportation sector and they can use the income from taxes in one sector to cover the subsidy policy in another sector. Now it is popular with smart grid technology so that micro generation from for example wind or solar can be input in the national grid. Later this year 2013 the central government will discuss this and possibly lead to a new act where this will be possible. We planner we work with planning and we think of PLD from the beginning. And also 10-15 minutes distance walking so that you can reduce the transportation all this is important. Land use, transportation, how to encourage bicycle use etc. This is also important for the energy use. I think a lot is happening in China. I think in the inner loop in Shanghai has become the most dense place in the World.

**What do you think about the changes in building regulations? And how does it affect architects?**
For architects of course it impact. For our office we suggest a lot of glass curtain. Now for residential and office systems it is not allowed. Now we have to think about the energy system. And it influences our budget and design. It has a big influence on our work.

**Do you have sufficient knowledge to design energy efficient buildings?**

I think now yes, there are some companies suppliers of windows, insulation or green roofs. Also Chinese companies are changing their practice. But I also think that this movement has strong support in all levels of the government. You know the Chinese cities are exploding and growing so fast.

**Are there cases when you need the help from ES companies for your projects?**

Yes of course. We need suppliers of different technologies; we have a catalog where they have the suppliers with material and equipment. We have to because we need some detail about the design to ensure the quality and consult about the budget.

**Has the demand from the developers changed? How has it changed?**

Yes it changes; they realize that it changes and that the initial investment is about 30 % higher. The budget is 30 % higher than for a normal building. And they say that this probably changes the attractiveness of selling our property and that it leads to lower energy operation cost and maintenance and management.

**Do the developers know how to build energy efficiently?**

They would rely on experts and suppliers. There are some EXPOs and meetings where companies with certain tech can communicate with the developers. I think this is needed. The developers are very pragmatic and they need to know in detail about the technologies, material.

**What is your role in retrofit projects?**

There is no space in Shanghai, and there are very many old buildings and it is very expansive to knock them down and it is most feasible to renovate them. We have a platform a website and then you can show them to local government and developers we are building it to communicate between the different parties. The platform is sponsored by the Shanghai government. We have thousands of cities and renovation of buildings they are urgent for ideas and they need good design companies and engineers and planners, architects and technologies. The platform is reaching with the government and big developers and designers and if companies have good eco technologies then they can be incorporated too. The plan is sponsored by the Shanghai local government and collaboration with the Ministry of Housing and Urban Construction also lots of activities and expeditions to allow them to visit the website. The platform is basically done. Please let us know if you have this kind of information. Our company has experience of working with the local government for 10 years.

**How does it help you to work with the local government?**
We know their need and how they work and their system; we have good communication with them it is our strength. We also we have inference we know what they are facing, we have good economic success. But in many cities in china the environment is very poor and many smaller cities get left behind. China still has the rural population. The challenges the local government meet are very big. So we know them the local governments.

What do you think is most important for the market to translate to clean technology?

I think the technology and the budget is most important, and the scale. Most cities have power but there is really a lack on water treatment system. Because power can easily be accessed also the transportation. But water treatment is very important and gas is important and difficult. For technology only by standardization it can be successful only by scale and that is the good business model. In the Chinese market the small niche is very expansive.

Do you think the ES companies should provide cheap technologies and not necessarily the most advanced?

YES!!! I think so yeah yeah I think it is too expansive and the scale and the population the scale it does not need to be too advanced.

Does it exist today?

It is still very expansive, like I mentioned it is 30 % more costly to build energy efficiently.

Is the behavior of the tenant changing how they use the energy?

I do not think so, behavior is not changing.

What should the ES companies improve in their operation? What should they do better?

More communication definitely. Let them know what the ES Company can provide. Also it is important to have examples of what they have done in the past. So the client can easily see the budget.

Is it important that the ES Company expand their service after the installation of equipment? Such as how to use the equipment properly?

YES! Definitely! We have many many new technologies but very few can play an important role in the transition for the industry. And how to integrate the tech and the usage need and the people uses. The equipment is still for people so the right people need to use it so it needs to be part of the service. It is interactively, you have good technology and then you have more communication with them and then you can figure out how to improve and make it fit for the people to use.

ABOUT THEIR PLATFORM

If you have info we can email us we have 5 people working on the platform, so we already have sponsorship from the government. The government is encouraging communication between the actors in the industry. The interaction is important. And on the platform you can put up your
technology and what you can do and then through the website the client can find you and contact you. For the time being it is a free service.

**Architect 2**

- No one likes to be first, especially when there are unknowns. It is always safer just to stick with what you know. The energy savings make sense on paper, but there are not enough real life case studies to validate what has been calculated on paper. Combine that with the fact that energy is still relatively cheap and you have a rough answer as to why no one is jumping on this opportunity.
- Next, consider something even more important: the developers who build are often not the final owners or the operators absorbing the energy cost. In other words, the energy cost is not the problem of developer... so why would he spend more money on extra insulation etc? Developers here aim for the minimum standard.
- This is changing. Developers are now starting to build and operate. The cost of energy is slowly becoming theirs. Combined with slowly emerging case studies, the shift will happen gradually.
- Note that most efforts in China currently revolve around high value propositions. Example, the system for heating the hot water for Tongji University, where 5000 students a day take long, hot showers. Or, recapturing the waste energy coming from the hospital flues (where the exhaust temperature is several hundred degrees). The only other significant efforts being done are for projects that are aiming for green building certifications... but even then, they are just aiming for the minimum to pass.

**Developer**

Date: 2013-04-10

Interviewers: Mathias Melander & André De Geer

Interpreter: YES [ X ] NO [   ]

If YES name: Jessie Liu, BA in Mathematical Economics, Fudan University

Language: English [ X ] Chinese [   ]

Total time: 40:24

**Recording: YES [   ] NO [ X ]**

Fang: We are leasing a lot of high quality and attracting offices in the central parts of Shanghai.

*More about the office rental services*

If the tenants want to change equipment, what can they change?

The tenants may not change anything related to the HVAC or fire safety. However, they are allowed to change lights and other smaller changes.
What is included in the rental fee?

Unlimited HVAC is included in the rental fee. The tenant must pay for lighting, appliance electricity and other services on their own.

What are the main priorities when the potential customers chose a new office to rent?

The most important thing for most of our customers is the location. The location has to be central and it should be close to the train, busses and shopping centers. With the ongoing decentralization of Shanghai, these locations increase in number.

The second most important thing is the handover condition, i.e. the condition of the office when you start to rent it. The general layout of the facility and the design of the office are also important aspects.

The least important is ventilation, lightning and fire safety.

Do the tenants ask for green or energy certified buildings?

The landlords are sometimes promoting it. It adds value to some customers but for most it is of no importance.

Are green buildings of certifications more important for a certain category of companies?

It is much more common that foreign companies ask for it compared to local companies. However it is getting more important for local companies to have a green profile which may lead to an increased demand in the future.

What impact would the green building standard have on the market?

It wouldn’t have any impact at all. But it would add value. Like I said, international landlords care about green building standards and big multinational companies thinks it is good.

How often do the tenants change office?

The larger companies sign 3 to 5 years per term and the smaller sign for 2 to 3 years. The companies usually stay a few terms because they spend much money in the interior design, such as furniture etc.

How important is saving energy?

It is getting more and more important all the time, and change happens fast. For example, five years ago Shanghai wasn’t decentralized. 7-8 years ago, there were no green buildings, but it is different now. An increasing number of people are interested in green buildings and it is the globalization and the international companies that put pushes for change.

Would energy services affect the tenant?
Because the demand is so high, it would have no effect for the rental fee for the tenant. The landlord on the other hand would see decreased costs. It is the landlord who makes the money, not the tenant. Therefore, the tenant has no incitement for green buildings.

Shanghai is such an important city. Many come to work in Shanghai others come for the education etc. Everyone wants to come to Shanghai. Five years ago there were only 5 districts that were included in the central Shanghai. But nowadays it is more and it is getting more and more all the time. People have to drive up to an hour to get to the where to their work in the central even they live in the central part. Land is not an issue but how central the land is located is, it affects the cost of the land. The market is the developers market and as far as we can see it will continue to stay that way.

*ESCO 1*

Date: 2013-04-12

Interviewers: Mathias Melander & André De Geer

Interpreter: YES [ X ] NO [ ]

If YES name: Jessie Liu, BA in Mathematical Economics, Fudan University

Language: English [ ] Chinese [ X ]

Total time: 50:46

Recording: YES [ X ] NO [ ]

*Explains the definition of ES, who we are and what project we are working on*

*Is this the same definition of ESCO as what NDRC require?*

The company offers indirect and direct services. The indirect services they offer include motivation for updating the equipment and increase their energy efficiency. The equipment used would not be randomly selected but most likely according to a list of requirements. For hotels information would be collected and then audits or recommendations would be given by the company. There are exceptions when they won’t follow ESCO standards, for instance, they would follow local standards instead when they do business outside Shanghai or when they receive specific requests from local companies according to the contract and local regulations. Plus, they operated in different ways when it comes to different facilities such as pumps in AC and steeling machine.

*How did they start the ES business?*

We started from Steel extraction and expanded their services to fabric and electrical industry.

*Why do they expand their services?*
One was their own that they saw an increased demand in the market. Second would be government subsidies that are promotion in all walks of life.

*How the government promotes it and why the market demand is increasing?*

The government would subsidize the company according to the efficiency of energy conservation outcome that is coal-equivalent.

Because there is a huge potential in all the buildings for actual energy savings. People are not considering saving electricity in the buildings. There existed too many buildings in the market that ignored energy conservations in the past decades, which brings great potentials in the energy-saving markets since there are stricter and more standards and regulations imposed by the government now.

*When did they start their business? Did the push from the outside or from themselves?*

Our company was established in 2010 which is relatively new. The needs mostly come from themselves where Baosteel would offer the main services. Most of their clients are still within their own industry.

*Which of these are they most interested in? Retrofit or new constructions?*

Retrofit most of the time, since there is already much energy saving considerations and regulations for new buildings.

*Do developers ask energy service companies to help when they set up buildings?*

In the first place, the architectural institutions would figure out the design regarding the national standards of the buildings and they would ask energy service companies for help if there’s something going wrong or if the technology is too complicated. They would be asked to fix the facilities such as ventilations or layout of the room for instance. More often ESCOs would be asked to assist in this phase.

*What is the competence in architects and developers?*

Obviously architects know more about energy saving while the developers only propose some general requirements according to regulations.

*What about the retrofit where non architects are involved?*

No. The architectural companies are involved in every respect both for retrofit and new constructions to renovate old equipment. Mostly the owners would contact the architects and the ESCOs.

*What is the role the developers play in this whole process or do the ESCOs approach their clients when want to change something?*
Developers would ask the architects to design according to national standards in order to go through the bid more smoothly and then the architects might get in touch with the ESCOs when needed. Developers are not involved in retrofit because they do not own the buildings.

*How will it be in the future when it comes to the ESCO market? Industry?*

There are new and stricter regulations concerning energy savings proposed by the government. Especially for projects that would consume a lot of energy originally. Plans that would consume too much energy would be rejected by the government. The project meeting the old standards would be rejected according to the new ones in terms of electricity, gas and water saving. It naturally invites more opportunities and potentials.

*What is greatest challenge in doing the project for ESCOs?*

Not enough funds from the clients and old-fashioned equipment. When it comes to renew the equipment that they are offering.

*What are typical problems during a project that an ESCO could run into?*

Two typical problems are financial deficiency. They do not have enough funds from the client and from themselves. Their equipment offered is not as efficient as they had expected. They would not get as high return of investment from an EPC contract.

*How could it be solved when it comes to financial problems?*

Bank loans and government/national subsidies.

*Do they get funds from the local Shanghai municipal?*

They normally do and especially when they perform better than the markets. It depends on the outcome of the project.

*How do you solve problems in disputes with clients?*

The standards are written in the contract that they would reduce the energy to a certain amount. And the customers could refuse to pay if they didn’t meet the standards or terms in the contract.

*Do customers breach the contract anyway?*

No. never.

*What is the difference between ESCO competitions?*

Different energy service companies spread out in all kinds of energy markets. Who can give the lowest cost and give the best approach.

*Do the technologies offered by the ESCOs vary among them?*

The technologies used by ESCOs are spread out.

*How do you get the contacts of your clients?*
We surveyed and researched our clients and offer suggestions and reports free of charge. And they would probably contact us. After that we get into long–term business relationships with them.

ESCO 2

Date: 2013-04-15

Interviewers: Mathias Melander & André De Geer

Interpreter: YES [ X ] NO [ ]

If YES name: Julia Liu, BA in Mathematical Economics, Fudan University

Language: English [ X ] Chinese [ ]

Total time: 58:10

Recording: YES [ X ] NO [ ]

**How do you view the potential of the ES market?**

Now china has issued some policies to encourage the ES market and energy savings. Like renewable use and renovating projects in existing buildings. Recently shanghai issued energy quota, we have some energy use limit for office buildings and hotels. Maybe in the future we will have some energy carbon trading. It is only a pan right now. I think the market in Shanghai is very good in Shanghai in general.

**How come your company been working in the ES market?**

We started the ES market in 90s such as ECM but it is has not developed well in China because some difficulties in financing and some policies. And the credit, because some smallESCOs cannot get bank loans from the Bank. We have not special policies to get these small companies financial support. So some small companies only do very small projects such as focusing on a pump or a retrofit. It is not the big projects. Some big companies have strong financial support so they can do bigger projects. Such as chillers and renovating also the energy supply side such as the chillers which are very expansive. So the clients do not have to buy them.

**Is it demanded by the client of the ESCO that the ESCO pay for the equipment or are Auditing also requested?**

Actually in China this is…. The client buys the equipment because the small ESCO does not have financial support. But recently during these two years the China government encourages the ESCOS to buy the equipment themselves. This has just stared during the last 2 years.

**Why would the central government want the ESCO to buy the equipment?**

Now the banks can give special loans from the bank and ESCOs can use the money in the projects.
Are the bank loans offered in all of China or in certain areas? For example given by the local government?

This is local government. It is different in different areas.

Who is administrating the loans in Shanghai?

It is the NDRC, they are responsible for the energy saving policies.

Also the loans?

They issue some policies to encourage the banks. But the banks have the right to decline a project. But most banks also see that there is a very big profit from these projects. So they might give the support.

Is this a trend?

Yes it is a trend.

How do you think this can develop in the future?

My understanding is that it will be more and more. We have many existing buildings. Every year we have 2 billion existing buildings in China. So it is more and more projects here. And most of them need to do some renovation so it is a very big market. If we can solve the credit then we will have a very big market.

Is the market focused on retrofit or new development?

Actually it is hard to say because we have many old buildings but also many new buildings. So it is hard to say. I know that in Sweden there is a big market for old buildings but not for new buildings. But we have still very many new constructions in China. But I know there is a very big market for existing buildings. At least now the ESCO market is focusing on new constructions.

Why do they focus on new constructions?

We have many projects and the government hopes to have low carbon cities and they encourage the client to have some renewable and low carbon cities so they do some incentives to encourage the clients to use it. So many clients like to have a good reputation in the society so they always hire consultants like us to give good suggestion in the construction.

Who is hiring you in a new construction?

It is always the developer.

In a retrofit project who is your client?

It is always the owners.

In a retrofit project are there any unique challenges compared to new constructions?
Actually we do not do any retrofit projects here. But I think in a retrofit project it is hard to find the funding, who will be the investor in the project. If it is a small project change some pans and fans or just enhances their FM management levels, it is very easy to solve this and make the project. But if they need to change some equipment like the cooling towers then they need some funding. Especially for the smaller companies they have to solve this. And most owners are reluctant to invest themselves.

**Why does the owner not want to invest? Do they not see the profit of the ES?**

Yes I don’t think they can see the profit of the ES.

**How do you find the clients as an ESCO?**

I have no idea about that. No no no sorry.

**Do the technology or service the ESCOs differ between the companies?**

I think it is a difference between the big and small ESCOs. The small ESCO just provide some knowledge and do small project. If they can get funding they can do bigger. Like the bigger ESCOs they always sell the equipment and also provide the energy renovation plan and they can, they have very strong financial support like Carrier. So the client does not have to buy the equipment separately. And the big company can solve all problems and then they can share the profit together.

**What do you think about the potential of the ESCO market in a few years?**

I think it is good potential. We have so many old buildings here. Most of them have very bad energy efficiency and actually they have very low and bad FM and some of the buildings have bad air quality inside so I think there is a very big potential.

**Do you think that the demand from tenants in the residential buildings for ES will change in the future? How would it change?**

I do not think so because in China the tenants have a contract with the owner and the contract is always based on the area so they do not need to care about the energy efficiency. No yeah no, maybe because in the future we can have a measurement for energy. So if you use less they will pay less. Previously they have only had the fixed area pay. Maybe in the future they may have a flexible payment also so they must care about the energy use. Now I am doing a park, project. It is a District Cooling District Heating project and the owners only provide heat and cooling to the building. They are not responsible for the demand side. So the building owner must care about the energy so they will care about the energy efficiency.

**You mentioned that the FM was poor. What services do they do currently?**

They are in a virgin state. Now they are focusing on energy but most FM they just have a very low knowledge about the facility system and do not know how the pumps and fans work. They just start and close them every day and measure the in and out temperature but do not know
how they function. The government has some training program to enhance the knowledge of the FM staff.

*Is the FM typically outsourced by the owners? Or do they have it in-house?*

Both, if they have some special outsourcing company to manage their facility system and focusing on energy system and energy measurement system to ensure the profit of the system. But I do not think this is common in Shanghai. But if it is a District Cooling District Heating system then the owners would like to use an outsourcing to operate the system. But very little ESCO companies have the knowledge to manage the energy systems. So it is a big market for the District Cooling and District Heating systems.

*Is this a growing market with District Cooling/Heating?*

Yes I think so after the expo many companies have started to focus on District Cooling and District Heating. Many Developers want to build low carbon parks and districts and implement smart grid technology and district heating. If it is a separate system most people think that it won’t have high energy efficiency. And they can integrate the renewable technologies. So they think that integrated systems are better.

*Do the developers seek the energy saving or the good associations from building green and using ES?*

I think that for the developers, it is a trend in China to build low carbon cities. And if the developer is a government then they have to be the pioneer. If it is a big developer then they want the good reputation. If it is a small developer then they hope the value of the land will increase. Most developers hope to build a building according to LEED or 1, 2, 3 star. And in the future they will be able to take out a higher rent now or in the future.

*Have you experienced any difficulty in contractual agreement using ES?*

Yes previously we always have such problems. Because the client did not agree on the savings that the ESCO promised. But now we have the guide or standard on how to calculate this.

*Do you know the standard by its name?*

Yes, Measurement and Verification of Energy Renovation, guidelines for measurement and Verification of Energy Renovation.

*Following the establishment of the standard is there still problems with the contracts?*

I think it solved much of the problem but also the credit is a problem and I do not know how to solve it. If the dispute cannot be solved anyway then they can solve it by legal measured.

*Is the standard issued by the government?*

Yes

*What type of technology do ESCOs offer?*
I think most of the companies they provide the heating and ventilation and air technology. They focus on the heating and cooling systems since they are very complicated and it has much equipment’s and fans and pumps and small things. And also it may have a strong relationship with automation and control. It is very different if you have a high management level maybe it has a very high energy efficiency and low cost. But if you have a very bad management then the cost is very very high. So many companies focus on the HVAC system.

The ESCO project does it stretch longer then the installation of the equipment and how?

Maybe they can talk this with the owner maybe they are responsible for the training of the facility management maybe they are not. But I think that because of the EMC they must have a payback so I think they have something after the installation of the equipment.

But when you communicate with the client do they communicate how much energy they can save or how much money they can save? What level is the dialog at?

The owners will probably focus on the money and the energy cost. So they will talk about the energy cost. I have not that experience before. Because we have different electricity price and the natural gas price can change so I think that they have to consider the whole energy market.

In a new construction how do other actors affect the ESCOs business?

For me I must have a good communication with the architect. I must check the scheme and see if the energy savings can be done and how to do it. In most projects we have to be involved in the design stage, construction state and the management stage. So we must consider the whole procedure of the construction. So we are always involved in this. Especially for LEED projects.

How much influence do the ESCO have in the Design stage?

We influence them to change the material used or some design. Maybe the simulations that we do can point out changes that should be done. We would give suggestions.

In the design stage is there a dialog also with the developers for ESCOs?

Yes

How is the knowledge among architects about how their design affects the energy efficiency?

It depends, energy efficiency is also important for the architects. But sometimes they do not think but care more about the design. And in those cases it becomes important to influence the architects.

Do the developers rely more on the architects or the ESCOS?

The developers would care about the energy. They struggle with the energy cost and must consider it in the design stage. Sometimes we are just energy consultants just consulting them how much they would pay for the energy.

Who would hire you in the new construction project?
Mostly the developer but also sometimes the architects when they need our support. But they do not like when we tell the architects that the scheme is not efficient.

*SHOWING THE CIRCLE*

Where is the Chinese ES market in the picture?

The market is very young and just started some 20 years ago. And it developed slowly. I do not think the market have entered the loop yet. But maybe the Chinese market is aware of the energy situation and it is increasing its outsourcing dependence.

What standard is most common in China?

They have different standard like the 3 star system. It has Arup, not traditional ESCO, rather design. Foreigner company. Can only be consultant. Most is construction and some is retrofit.

ESCO 3

Date: 2013-04-15

Interviewers: Mathias Melander & André De Geer

Interpreter: YES [ X ] NO [   ]

If YES name: Jessie Liu, BA in Mathematical Economics, Fudan University

Language: English [ X ] Chinese [    ]

Total time: 47:16

Recording: YES [ X ] NO [   ]

What is the market for ESCOs in Shanghai?

Maybe I could give a little introduction to what we do? Actually, it’s quite a big market and it’s growing fast. We can only take about 1.5 % of the market. The government has issued subsidies for the local green buildings certification and it is quite a big number. It can cut all the cost for green building issues. Part of the Chinese market would go for some kind of green building certificate. For these who want to get LEED certificate or local 3 stars. There is two drivers. One is escalator company American company, there is some kind of policy they got and they want to invest in it. Another is local developers who want to attract some kind of foreign companies who rent offices in high rise buildings. Honestly for local investment many are just after subsidies others is because the government want them to do it.

For us, we want to advice double certification for a project. If we get star certification we get subsidies and if we get LEED we increase the value of the building.

The subsidies, are they local or central?
They are organized by the central government but you have to apply to the local government. It is governed by the ministry of construction and it is a direct subsidy. It is based on the gross floor area.

For a two star rate it is 45 RMB per square meter and for a three star it is 80 RMB per square meter. The local government also give subsidies of about 60 RMB per square meters, if you add these together you will get about 100-150 RMB per square meter which adds up in big projects like for example the Wuxi project. This will cover most of the expense to do the green building certification.

**Would it cover the cost in the long term? Does it lead to energy savings?**

Theoretically, the green building label would reduce the cost of energy used. In the United States it does to about 30 percent. But our experience in China is a little different because we use different kind of system than the US. People here the time we use the HVAC is much lower than in the USA. Even we have a LEED building here then it would even use more energy here than a normal project. Because we use many VAV systems compared to a fan system. It is comfortable but not energy efficient.

**You mentioned that the demand for LEED comes from foreign companies. Does that have to do with this? That there is actually no energy saving from these certifications.**

The local Real Estate company want to attract the foreign clients and get the building certified also they get better price from their clients. If the local company no such aspect, maybe he go not, he will not go for LEED but the local 3 stars.

**Are there any subsidies for the international certifications like LEED?**

No, it is only for the local.

**What do you think about the future of ESCOs?**

The competition here is quite big. I think for in the next five years it is going to be like now. But the prize will go down. But the demand will be higher. But five year later we do not know. There will still be subsidies and there will be more projects and more demands for this kind of certifications. In five years it is really good business. We try to add something more to this kind of energy service, we provide a package service.

**Why do you expect the demand to increase in the next five years?**

We have the subsidies. The China local classification will be a requirement for all new buildings. If we for example look back 2-3 years we will see a significant increase in LEED projects. You can find in the BGCI website many certifications number have increased. Take the 3 stars in 2012 for example, it is doubled, doubled! Before, it was 700 or something, now it is doubled! So for the next five years we can see good business, but it is hard to say longer than that in five years.

**Is it the developers who find you, or are you seeking them?**
We are a multinational company so we are trying to work with them mostly fortune 500 companies. Maybe for the 3 star certification we want to work with the local companies. We have changed, the working style is a bit different, but we have to, it is a big market for us.

As a customer, is there a big difference from the multinational and local companies?

A little difference. Even if a local company wants to build a high quality high rise certified office, he will employ the multinational consulting companies. They want to use the first class multinational companies to keep the quality. But in China, all the foreign companies can’t do what we call the construction joins because that is against the license. So all the multinational design institutes have to work with local design institute so the government controls the final part but the schematic part they work with multinational company.

Is it because same quality can’t be delivered by local companies?

I think there are two reasons. First of all, I think the multinational companies will give some kind of good quality product. In the end, if he uses this kind of company it sales on the market.

Do you employ other ESCOs to assist you?

We tried to apply as the ESCO Company first and they approved us. And when we wanted to get the certificate they said no you are a consultancy company. In the current mechanism the ES Company was reserved for EMC companies. We don’t want to invest in energy services; we want to do the consulting. We did not get our certificate. We can have partners who do the investing if the clients want. So for energy efficiency we work with a third part do some survey and energy audit. We have it internally also the energy audit.

How is the demand for these services?

Actually it is a challenge because in China most of these are done by manufactures like York or Carrier. They can provide the consulting for free and then sell the product. Another part is done by ESCO companies that do the engineering work. The clients often wonder why they have to pay for the energy consulting when for example Carrier can do it for free.

What is the market for energy audits in China?

China also wants energy audits and energy efficiency label. It has been done for consumer products but now also for buildings. All the new constructions have the energy label and then it can be sold or rented. It is mostly done in large scale public buildings and hospitals and star hotels it is mostly paid by the government. Even in the government buildings there is a discussion about the data, they think it is their data and don’t know why they should share it.

Why is the data so sensitive?

They just don’t know why they should share the data with you. I think for buildings it is easier, but for industrial buildings it is hard. They are very concerned of their data and don’t want to share it. For industrial buildings most of it has to be paid by the companies itself, but the
government gives subsidies for it. For energy audit, the government will give 30 000 RMB per energy audit if you do detailed energy audit you can get up to 60 000 RMB for it. But even with this, some companies don’t want to do an audit and share their information with the government.

**Do you think this is more limited to foreign companies?**

Not in particular to foreign companies. Normally you would have to sign a non-discloser document for the project.

**How about the in-house competence, do the companies have the competence to know how to increase the energy efficiency?**

If we go to a building, we can find 20-25 things to do in a building. If we go to the industry it is about 10-15. Every time we go to the Facility Manager no mater it is a facility or a building they do not want our help and they feel that they can do it themselves. If we get a chance to work closer with them, most of the time they will accept us and we can work together to develop some opportunities. But if they close the door we have no chance.

**Facility management, is it often outsourced or in-house?**

It is interesting. For the industrial building, most of the facilities are managed by the owners themselves. But for the buildings it is different. Most of them are operated by a 3rd party. It is therefore easier to work with the industrial buildings companies compared to especially office buildings but also shopping malls. The energy cost is paid by the clients renting the office spaces so there are no drivers for the property management company to save energy. If they change the lights, they have to pay for it but they won’t get anything in return.

**The tenant doesn't really have any influence on this?**

I think very few of them do. Most do not care about it

**If the owner wants to do it, is it possible then?**

Yes, but then the owner has to pay for it.

**Why do you think people react negatively on energy audits?**

In China, audit means you are to check if you can find problems. If you instead say you’re doing energy efficiency consultancy for them, they will feel comfortable. In the future the Chinese government is trying to establish energy usage benchmarking tools for different building types. They are currently gathering data in buildings. In the future, if you are consuming more than the set limits, you will have to pay more, much more like 1.5 times more for the electricity. This will happen to the commercial buildings later

**For energy management contracts, is the situation very different?**

The government has put subsidies to EMC projects based on the energy saved by the project. In Shanghai it is about 600 RMB per tonne standard coal and in Beijing about 550. The
government is also reducing the tax for this kind of EMC projects and they are also trying other subsidies.

However, there are still some problems with the EMC. One of them is how much energy was actually saved? Because, there is for example different production levels in industries and different working hours and climate differences in offices. It is therefore sometimes hard to get a proper number of the actually energy saved. The government is therefore trying to develop standards and guides for different types of office buildings. I think that is a progress.

*Is it the same resistance towards EMC projects as with energy audits?*

It will be easier because they don’t have to pay anything. If for example EMC projects it will be easier.

*Have the ESCOs done well?*

They earn money from good projects, that I know. For easier things, like changing lights, that is no longer something the ESCOs do because the clients understand that they can easily do it themselves. For HVAC and other more complicated systems, some of them are doing well but I am not sure about all the market.

The problem is the agreement about energy savings. A friend of mine is running a company like this and they are making agreements on how much percentage energy they are going to save and they get a fixed payback each year. It is more safe for them. For example if I invested 2 million RMB and the contract is 16 years and if we could guarantee energy saving of 20 % I would get 500 000 – 600 000 RMB. They don’t want to share the energy saved because it is harder to get an exact number.

*What do you think about the future market?*

I am not very involved in the ESCOs but I think energy efficiency is the future. We think energy efficiency is the future because for green buildings it’s just like leveling things. ISO 9001 and 14001 it goes down rapidly the demand. But energy efficiency will continue it is not a onetime effort.

There is a focus on local carbon emission systems. China has put about 5-6 cities as pilot cities like some kind of internal trading system. In Shanghai they have issued a list of around 200 companies and buildings that have to involve this kind of emission trading systems. This can be related to the energy efficiency being a carbon asset. However, at this time only local companies are involved.

*What actors do you work close with?*

For us, the most important is the project developer design institute. After we are involved in the project it is consultants, AMIP-consultants, Facility consultants and also green contractors. For existing facility it is the facility management.

*What are the difficulties in the retrofit market?*
I think, environmental protection is easier than energy efficiency. This is because energy efficiency you can save money but for environmental protection you only do it because it is required by the government. Energy efficiency is today mostly voluntary, but if the government makes it a requirement in the future the market will be better.

*You don’t think today’s market understands that it is financially justified to invest in energy efficient solutions?*

Some companies realize it, but most of them do not. This might be due to bad experiences with ESCOs and their projects in the past which has affected other clients for ESCOs. And secondly also the facility management only wants to manage the facilities. Why should they do the extra job if there are no such requirements from the government? But it will get better when they get more understanding and when the government put more requirements on them.

*What could be the contractual challenges for the ESCOs?*

For ESCOs mostly it is the agreement with energy saved and how to return the equipment to the client. For a new construction I think it is mostly for a delayed or cancelled and the client do not want invest the money. Other times it is just because the consultant is not so good.

*ESCO 4 & 5*

Date: 2013-04-16

Interviewers: Mathias Melander & André De Geer

Interpreter: YES [ X ] NO [   ]

If YES name: Jessie Liu, BA in Mathematical Economics, Fudan University

Language: English [   ] Chinese [ X ]

Total time: 42:22

**Recording:** YES [ X ] NO [   ]

*What type of energy services do you offer?*

Actually there are many aspects of energy saving consideration for example new or existing building. We especially give ES for existing buildings, retrofitting to improve the energy efficiency. We change the equipment of the building, for example, chillers and lighting and HVAC systems.

*How long have you operated in the market?*

We started 2011, so it is a very small en new company and we are very young. We have around 40 people in the company and the majority is engineers.

*How come the company was founded? Was there an external push?*
The government promoted this kind of company. The government gave subsidies for this kind of company. This emerging market has more potential profit than other market and the market is rising.

**How is it to operate as an ESCO in the market?**

The government did not help this kind of business in the past decade. This kind of EMC had not been developed well in China in the previous years but now it is becoming more developed and popular. Another factor that was a disadvantage before was that the clients were not so aware of this kind of business in the past so they were quite suspicious about this kind of business. But now since the media the government gives this business attention and the government and the banks will give this kind of business loans and they are promoting this kind of business so it is more and more popular. And it is becoming a more competitive market since more and more client knows about this type of operation. And the client nowadays wants to select among more ESCOs before hiring one so the competition is rising.

**What is the clients asking for and benefit from you? Energy-saving cost or the amount of energy saved? Or other services that you provide them with?**

For the government, they care more about the exact amount of energy saved while the clients care more about the cost of energy-saving. So what drives the market is of course the cost of the energy reduction but the government subsidy is mostly according to the exact amount of saved energy.

**Do you think the market would survive without government subsidy?**

The market would shrink to less than half the size if without subsidy, and be hard to survive. As for the energy saving investment it is long term relationship and the client would care about the risks involved in the project. Also the price of the energy in china is comparatively low compared to abroad so the profit from this service is lower than it could have been.

**What are the risks then?**

Risks that are resulted from Policy or regulation changes occurring within a couple of years. This is not the main point because the government is promoting this business. Business cycles can affect the clients and their choices and how they prioritize these projects. External incidences like natural disasters or economic recessions and low energy prices in China. Compared to architectural industry that is less risky, other industries like steel, raw materials are in unstable operations that causes longer payback period. These industries are more risky to work with in an EMC contract. Sometimes they have no money to pay for the EMC contract.

**Is it always a long-term contract or short-term as an alternative?**

Most of the time, yes. At least 6-8 years on average, some companies even do the contract up to 15 years.

**Do the clients demand that long-term contracts/relationship or is it possible with shorter contracts?**
The ESCO would not get so much profit if the contract is so short. It is not feasible for short-term contract to be in operation. Our payback time is for example now at 2-3 years so we need to contract the client for more than 6 years actually. This is typical for most ESCOs in China.

**Is the product services very similar, for instance, the technology, among ESCO companies.**

Yes, almost the same concerning technology. It is very difficult to make a new invention. So the technology has converged that the ESCOs are offering.

**So is there any difference between the ESCO services?**

The government is more into packaged services instead on the services that are specified to one service. So the difference lie in the level of competence within the ESCO company, which involve the research stage and proposal of a scheme that is appropriate for the project, financing, construction, operation and management. These are the main points that differentiate the different ESCOs in the market. There are only 40 people in our company but most of them have very strong education. 3 of them are PhD and most of them are senior consultants. This is rarely seen in Shanghai. It seems like the simple job but actually it is hard to operate it.

**Is there some other work demanded after the installation in office buildings?**

There are two stages after the scheme is presented. The first stage is getting into contact with the client and negotiates with them. Most of our clients are from hotels and hospitals. Which require higher standard of the space are which result in quicker payback time for the projects.

**Why shorter?**

Because there is greater demand in hospitals and hotels for energy saving 24/7 but not the same case for office buildings. The energy use is higher in these buildings.

**What role does the tenants, facility maintenance staff have in your ES projects?**

Tenants hire facility maintenance staff while we are only in charge of covering the expenses incurred during maintenance. We are responsible of installing the equipment.

**Are there any problems involved in this complicated relationships among the actors?**

Not really, they would get in touch with us only if something goes wrong and we don’t need to be on the spot for the operation. We are only responsible for the maintenance not the operation.

**What is the greatest challenge?**

Marketing and Sales, because of fierce competitions in the market and the need of pulling some strings among the clients for better sales. Connections are important and more important than in western countries. It is also a problem that many old buildings are built too poor so they cannot carry the weight of new equipment.

**Do you approach the clients first or the other way around.**
The former most of the time. In general they approach the clients. In a retrofit project they normally check the building and then when they need that there is a need they contact the client.

Are they aware of the energy saving conditions?

There are very rare cases when the clients are in very well energy saving conditions but more often than not they have little knowledge of the technical details and measurement which we need to help. If we find that it is possible with a payback within 2-3 years then we like to sign the contract. Most of the clients are aware of the general savings of the building but few are aware of the specifics how and what could be saved.

Is there a specific reason why many of the clients have not done energy savings before?

Yes. We asked and learned from them from time to time.

What do you think about the market in 5 years?

Huge potentials in the market in the next 5 years. As we know Shanghai and other cities are building a lot with many good clients but not excellent energy service companies so far. That is how we need to improve, down to the finest technical details to meet greater demand for service quality in the future.

Government subsidies according to national standards: 1t standard coal, 500 RMB, 15-25% 20% 25% plus 30% energy contracting management standards

Investor

Date: 2013-04-19
Interviewers: Mathias Melander & André De Geer
Interpreter: YES [ ] NO [ X ]
If YES name:
Language: English [ X ] Chinese [ ]
Total time: 48:35
Recording: YES [ X ] NO [ ]

Are the SOE investments economical?

They don’t really care about the market value of buildings. They can pay a great amount of premium for buildings. For example in the north bund it’s for strata sells it’s about 50 000 per sqm but SOE can pay up to 70 000 per sqm even up to 87 000 which is about 30 % over the market transaction value. These buildings are just turnkey project or contractual projects before it is completed for they have quite sustainable buildings.
The other reason for SOE are willing to pay more is that they have a more long term perspective. They use it for self use and will be in their book for a long time even extend the land use. For most offshore pe funds or rmb funds it is about 5 years plus and option to extend for one year for offshore funds. For onshore it is most likely 3 years plus one. Therefore they are looking for 5 and 3 year terms and what kind of return that the project can deliver during this time. But for energy efficient buildings I think I take longer time to payback the initial investment, therefore I think it not quite works for those fund players. Only for SOE as they look in longer terms. These energy costs may be offset in 10, 20 or 50 years which may be saved on operation cost of the building. Different investors have different perspective, time scale, etc. At the EXPO site in shanghai I think there are very large projects around 1 million m² commercial land including office buildings and retails. These are also turnkey projects for SOE. The site used to be very old residential place but all the buildings have been demolate. Before the expo and after the EXPO some buildings have been retained but some have been clean land and this area is used for SOEs and very efficient energy use. Because t

Do you think the payback time is one of the biggest reasons for companies not investing in efficient buildings?

Yes, the initial investment cost is too great and is likely to be offset in 3-5 year term. Lot of funds can easily find old buildings, like 10 year or 15 years and they will refurbish the building to add value to further improve the rent. Some of the commercialization, some of the business parks, 5 or 10 years ago it was industry land but now it is commercial places. For some core area buildings, the building age is 15 years and the funds are interested in investing in these core locations and have the potential to improve the building quality and add value to the rental income. For those project I can see most of the refurbishment is external, to make it look good, not really for energy efficiency. In Shanghai and most cities in China there are different types of air conditioning systems like VRV, VAV. VRV is something new and very energy efficient; you can control the machines by units and if you don’t use one you can close the unit. However, most buildings still use the VAV system which is not quite energy efficient. But in peoples concept a grade A building mostly use VAV system. This is most likely caused by the tenant perspective.

What is the investors’ knowledge of energy efficiency?

They know about LEED certificate and just on the market you can hardly see that these transactions of energy efficiency can add value to the buildings. Most of the investors still try to improve the refurbish like the low base, external the walls that can improve the tenant profile in short term. If you really need to refurbish the buildings and do energy efficiency measures, it takes a long time with all the equipment and this is a problem. This will eventually affect the IR. Energy investments costs a lot of money and takes a lot of time and the return are 5 or 10 years later.

What do you think about the property/Facility management how is it affecting the energy efficiently of the buildings? Is it likely to be outsourced?
Most of the foreign investors outsource this. For insurance and SOE they use pension money for the investments and may have their own teams for this, they are looking in much longer terms not like the funds.

**Have you heard of ESCO?**

ESCO? Not quite sure?

*Explains ESCO*

What I mention is from the investors point of view but the market action still need some driver points by the giov and the industry if there is such standards of buildings. Because currently for grade A building there is still not so specified requirement for energy efficiently it is only for the AC needs to be VAV not VRV. I think we can see just some LEED like silver or gold certificate one building was sold in the north bund with gold certificate which the price was quite high above the market maybe the energy efficiency certificate added some extra value.

**Which standard is more popular?**

LEED is much more popular. We can hardly see LEED gold certificate in Shanghai only 1-2 buildings. For big developers like Cejung land big HK developer, some of their core assets qualify for LEED certificate but only for the buildings in very core location. Because it is still in China very premature by the tenant perspective and the investor perspective. Only in the Europe where they have such legislation for such energy efficiency.

**What do you think the government could do to change to more energy efficient buildings?**

In Copenhagen there was a commitment among countries. But in China, most of the industry is trying to upgrade most of it has very low profit margins. For service companies or financial companies, they have higher margins and are willing to invest in more expensive buildings. Especially with the appreciation of RMB funds, because their profit is just corroded by the currency. You can see that there is a lot of pollution in the cities and every cares about that because it affects the health. But it is very hard to restrict the industry because many people may lose their jobs. There are some big steel companies in Shanghai, like Baosteel, it used to be in the city center but because of the air pollution they had to move outside of the city. We can see some actions like this taken by the government but it will still take time because China is still a developing country.

**How can you measure the value of energy efficient investments in buildings?**

Basically, we calculate by the actual cash flows. For most buildings investors require IRR over 15 % for stabilized buildings. Insurance look at yield, net operating income at around 5 % in core locations buildings. For foreign investors it is very hard because the time scale affects the IRR returns, but for insurance companies they only look at yield perspective. The time will offset the cost of investment for energy equipment. I think in 5 year later the yield can be improved by quite a lot because the operating cost can be cut down quite a lot by the energy efficiency investments. It still depends on different investors. Insurance looks on longer term.
If you are looking at what return energy efficiency can bring to the project, I think you should look at incremental cash flows that the refurbishment of energy efficiency will bring to the project. The incremental cost and incremental cash flow. Apparently which will improve the operating cash flows. But it is still a time, how long?

**Do you think that services with short payback time would be more interesting in Shanghai?**

Not the payback time, but rather the net cash flows. You need to distinguish the cash flows from the energy efficiency side and the incremental return that investment of energy efficiency equipment brings to the project. Payback is mostly used in European companies? Most institutions will look at the IRR. There is a cost of money, if the investment can give returns above their cost of money then they will certainly invest in the projects.

**How do you set the rent for office spaces?**

Actually, different investors have different perspectives and hurdles. Basically, most of the investors look at the entry net operating income yield which in Shanghai most of the investors investing office buildings in core locations the NOI yield will be about 4.5 % and in suburb location it is above 5 %. All the futures are based on projections for rental growth and operation costs will carry on the building. The actual figures are what happen now, the entry NOI. You may not only look at the cost but what rental premise that can be charged from the tenant because some of the tenants have such tolerance for much higher rent. There are only 2 LEED gold certificates in Shanghai so that will certainly improve their image to the clients. There are two parts the total improvement turnover and also the reduced cost by installing efficient equipment. Some tenants are willing to pay more for energy efficient buildings, so it is not only the energy efficiency savings.

**What are the tenants most interested in?**

1 locations location locations
2 The hard aspects like building quality and the facilities of buildings, amenities.
3 The soft side, like property management, quality of tenants: The 500 fortune companies are more likely to lease in buildings with well renowned companies. With improved tenant profiles, more tenants will follow.

In core locations there are not so much new projects so it is more likely that LEED projects are in the secondary areas. The premise tenants pay much higher rent in core locations so in the secondary location the premise may be a bit limited. In central areas tenants can pay around 10-14 RMB per day and m² but in secondary location like the north bund and sujanbaju there the rentals are much more stable and around 6 RMB per day and m² and the premium you can charge at most is around 1-2 RMB per day and m². In the core location grade A buildings the premise is much more fluctuating. And the premium can be quite high up to 10 RMB per day and m². In the core location some buildings are a bit old so people need to refurbish them.

**Do you think the energy cost is a large part of the total operating cost?**
I think for office buildings most of the operating level expenses are around 30% of the total revenue. The total revenue includes the rent, car parking, property management fees, utility fees etc. Within this 30% operation expense I think around 8% is about the energy cost. That is quite a lot for building because it will accumulate year after year. The problem is how long it will take because the investment for energy efficiency technology can be quite big in relation to what it can save in energy cost.

*Is it better that the energy service company or would still some investors be willing to invest if the payback is short?*

For developers, insurance companies and SOE end users are willing to pay, but for short term investors fund investors I cannot see such tendencies. In my study there is one building near People Square completed in 1997 that looks very old. It is an Irish front and it is listed on Singapore exchange for Ritz. The building was bought in 2006 and renovated. The rental was about 4 RMB per m² per day when they bought the building. They only renovated the entrance and lift lobby and common areas and the rental jumped to 6 to 7 RMB within 2-3 years. They only improved the external, not the energy technology, because now it looks very high quality.

*So it is more interesting to increase the rent than reduce the operation costs?*

It is much easier to raise the rent by minor investments in external decorations rather than investing in the equipment. It takes time, and it is expensive. For fund guys, it is not interesting to invest in energy equipment.

*What would be problematic for an ESCO in this market?*

I’m not very sure about ESCOS. I think the ESCO services depend on how much they can save on this kind of service for the owners. The owners are certainly looking for ways to cut down costs. Since the inflation is quite high here and the labor cost is rising quite quickly. If a company could cut the costs beyond the service fees, then it would be interesting. Because certainly the investment take time and is costly. I think the owners need some kind of case study where they can see how much the project can save.

*If a company says you can save this much in energy, would the owner trust them?*

They certainly need to do some assessment and cash flow calculations. If the company can show a case study on how much money they can save, then certainly the owner would try I think, especially for the developers.

*Do the developers trust a company they haven’t worked with before?*

I think they will trust but most certainly do they need to show a track record of what they have previously achieved. It really depends on how much the owners can save on the project especially for the developers. Normally the owners would compare between different companies propose, what they charge, the track record and performance etc. A company with a strong track record that can prove that they can save cost for the owners I think most owners would try it.
What do you think about the future?

I think in the future, because of air pollution and stuff people will start to think more about how to protect the environment. Especially the government will certainly look at these aspects but it will still take time because China is a developing country and do not want to hurt the industry.

The industry will move to smaller towns instead of big cities because there is a high density of people and the pollution will affect the people’s life. The awareness is there, but it takes time to put in legislations and change people’s ways of thinking for the tenant and the investors.

The end user?

The end user cannot look into the building that deep. I think certainly that the market needs such a case that is big enough to arise the people’s awareness for the developers, investors and tenants. In very core location where there is a high energy efficiency building with good quality. Maybe for the tenant it can reduce their property management fees and for the owners the operating margins.

What kind of property management do the tenants pay for?

In Shanghai for most grade A buildings they pay 30 RMB per m² and month for the tenant to pay this money for the maintenance of the building. For new buildings they use the VRV system so the tenant can control the AC system so the pnv will be much lower like 18 RMB per month and m². But then they have to pay the utility fee themselves. But these are not grade A buildings. The people need a case that can illustrate for either party that the energy efficient building brings more value for them. So I think it will take some time, not now but maybe 3-5 years later.