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Growth and Development of ESCO Markets

The Case of Lund, Sweden

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The International Institute for Industrial Environmental Economics
———— Internationella miljöinstitutet ————

The debate today between commerce and the environmentalists today is growth versus no-growth. What a ridiculous debate. Commerce is saying that they have to have growth for the interests of commerce and the environmentalists are saying that growth is destroying the world. But isn't the question really: What do you want to grow?

- William McDonough, US Architect and Designer

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Abstract

An energy service company (ESCO) is an example of an atypical business concept that generates greater positive externalities as its business grows. The basic business concept of an ESCO is a company that installs energy efficient improvements in their customers' buildings, such as new lighting and ventilation systems, and then recovers expenditures and gains profits by splitting the resulting financial savings from reductions in energy use with their customer. These energy savings are gained over a period of time and are evaluated and quantified financially according to the details specified in a performance contract between the ESCO and their customer.

The main objective of this thesis was to assess this potential for growth and development of the ESCO market in Lund as demonstrated by four potential actors, three real estate actors and one energy utility, within the Lund market and general Swedish ESCO market conditions. Evaluation criteria were used as tools to evaluate three Lund real estate actors as potential ESCO customers and one Lund energy retail supplier as a potential ESCO.

The size of ESCO markets in Sweden and globally do not correspond to the current cost effective energy efficiency measures that can be undertaken. No insurmountable barriers were identified for performance contracting to occur within the three real estate organizations in this study. Policy instruments could, however, serve to make ESCO contracts a smoother and quicker contract process allowing for the market for this business concept to grow.

Executive Summary

An energy service company (ESCO) is an example of an atypical business concept that generates greater positive externalities as its business grows. Externalities are effects that are not taken into account in the price of a good or service. The basic business concept of an (ESCO) is a company that implements energy efficiency measures, such as adjustments to ventilation systems and installation of new lighting equipment, and then recovers expenditures and makes a profit by splitting the resulting energy savings with their customer. These energy savings are gained over a period of time and are quantified financially according to the details specified in a performance contract. .

Final energy consumption in buildings is estimated to account for almost 50% of CO_2 emissions throughout Europe (Commission Proposal COM(2001)226 final). A variety of social, institutional, financial, legal, and other factors all serve to inhibit the energy savings potentials corresponding to current potential cost-effective investments in existing buildings from being realized. One method of capturing energy efficiency opportunities and reducing emissions associated with power generation is to use the private sector as a vehicle through the use of ESCOs. ESCOs can enable cost-effective energy efficiency projects to be implemented through the package of services they provide. These services can include project investment or arranging for financing, a guarantee on energy savings, technical expertise, project management, and training of a customer's staff.

The geographic focus of this thesis is in Lund, Sweden and with general Swedish conditions; however, global case studies and literature will be discussed when relevant. The scope of an ESCO's activities is with energy efficiency in existing buildings.

The main question of this thesis is:

What is the potential for growth and development of an ESCO market in Lund? What actions are needed to realize this potential?

In attempting to answer this question, this research will examine organization (potential ESCO customers and potential ESCOs), market, financial and legal, and policy perspectives. The word growth here means the absolute increase in the number of ESCO projects and total market size (revenues) of all ESCO projects combined. According to economist Herman Daly, to develop means "to expand or realize the potentialities of; to bring gradually to a fuller, greater or better state (Hawken 1993, p.140)." Two areas of the development of the ESCO business concept that this thesis addresses are the development of the ESCO market to include energy suppliers as ESCOs and smaller customers as ESCO customers.

The main objective of this thesis is:

Assess by using evaluation criteria the potential for three Lund real estate organizations to become ESCO customers and one Lund energy supplier to become an ESCO

A sub-objective of this thesis is:

To identify and analyze existing and potential polices that may be used to aid the growth and development of an ESCO market in Lund

Interviews were conducted with representatives from the four Lund actors in this study, representatives from four Swedish ESCOs, and other actors. Evaluation criteria were used as *tools* to assess the potential for the three real estate organizations to become ESCO customers,

and for Lunds Energi to become an ESCO. Interviews with Swedish ESCOs were used to fill in knowledge gaps from the literature review in identifying these evaluation criteria, especially concerning the Swedish ESCO market.

The three real estate actors in this study are Akademiska Hus i Lund, Lundafastigheter, and Region Skåne. They are all real estate organizations that rent out to government or university (which is largely funded by the government) tenants. Region Skåne and Akademiska Hus i Lund both have larger scopes than Lund, however, only their activities in Lund will be evaluated as ESCO customers. Akademiska Hus rents i Lund rents out to Lund University. Lundafastigheter rents out buildings to Lund municipality. Region Skåne rents out to tenants that mainly encompass the health care system (also dental care, culture and regional development, including regional public transportation).

The decision was taken to focus on public actors because they typically make good ESCO customers due to longer planning, acquisition of third party financing at more attractive interest rates, and ability to deal with longer payback times (Goldman et al. 2002). Public organizations generally have good credit ratings, however, knowledge barriers may inhibit them from seeing their profitable energy efficient investments, and institutional and political barriers may inhibit them from undertaking these investments once they are understood. Lunds Energi, a provider of district heating and electricity retailer, is analyzed for its potential to develop its business concept to include performance contracting. The three real estate actors are all district heating customers of Lunds Energi.

Results

The main barriers toward achieving greater energy efficiency within all or some of the three Lund real estate organizations in this research were found to be:

Billing Structures, Fixed and variable electricity pricing - The marginal cost of electricity is not reflected in the price.

Billing Structure, Split Incentives – Neither tenants nor a building's owner/operator/investor have an incentive to invest in energy efficiency as the billing structure does not allow them to adequately recover and profit from this investment

Power - Political barriers in that short term political cycles make it difficult to have a long range plan or vision for energy efficiency in municipal buildings

Priority and time - Priority is given to other investments closer to the organizations' core competence. This can be reflected by strict payback requirements for investments in achieving greater energy efficiency. Also, there is a lack of available staff to implement energy efficiency projects.

Availability, quality and access to information - Metering of energy use is not checked, not working properly, and/or is in too few areas to determine an adequate picture of energy use and estimate cost-effective energy reducing investments

The three real estate actors are all implementing or starting to implement new energy metering systems and are taking steps to create incentives in billing structures for tenants and/or building owners and administrators to reduce energy consumption. Performance contracting can alleviate barriers in access to capital. According to the case of Region Skåne, perceived or actual legal barriers with public procurement for performance contracting can be overcome;

however, a better standard framework for working with this issue would help future projects. The remaining main barriers toward achieving greater energy efficiency within these organizations involve the price of energy and are considered outside of the scope of an ESCO's activities, except in the possible case of an energy supplier who has the ability to adjust rate structures. These barriers could be practically addressed by incorporating externalities into the cost of energy and/or through the use of time of day pricing. However, interview respondents generally preferred fixed electricity prices, however, over time of day pricing due the perceived greater simplicity and convenience of having fixed prices.

Akademiska Hus has a fair amount of capacity for implementing energy efficiency measures. They have 20 technicians and four property managers based in Lund. They are investing in new systems of energy supply and delivery for their buildings. The focus of this organization's efforts over the past ten years toward greater energy efficiency, however, has been on the adjusting of existing systems and not on investing in new ones. From 1993 to 2003 Akademiska Hus reduced the electricity and heat usages per square meter in its buildings at Lund University by an average of 10.9% and 27% respectively. Given all of these strengths in the implementation of energy efficiency projects the director of technical management of Akademiska Hus i Lund stated that the area where an ESCO could provide useful resources would not be in financing or adjusting of their existing energy systems.

According to Stig Hoff, payback times for investments taken by the Akademiska Hus organization for all of Sweden generally fall between three to five years, although they can run as long as eight to ten years. The longest payback times that ESCOs interviewed in this study underwent for their projects as a whole was about 10 years. It is unknown whether or not there are some investments in energy efficiency that an ESCO might enable that would not otherwise occur by providing investment and/or guaranteed savings. One area that an ESCO might provide valuable services to Akademiska Hus is, according to their head of technical administration Roland Larrson, providing technical expertise in the installation of new equipment and to avoid the cost of hiring new staff for a specific project. The Akademiska Hus i Lund branch in Kristianstad has used an ESCO for these purposes. On the other hand, given its existing strengths Akademiska Hus also can concentrate its efforts on its growing internal capacities. One way to aid this development might be through the use of the "internal ESCO" or intacting concept. This would allow a more direct transparency between investments in energy efficiency (and possibly environmental management in general), and the gains from these investments.

Lundafastigheter is focusing their efforts towards achieving energy efficiency on the use of their existing staff and capital resources. The interests of the short term political cycle along with yearly budget changes, needs of buildings, laws, and the satisfying tenant demands that are received all may serve to push out the interest in investing in energy efficiency. The consistent and guaranteed financing of an ESCO could alleviate this barrier and contribute to their existing efforts in training their staff, however, the information collected in this study is inconclusive regarding the energy savings potential that an ESCO could help Lundafastigheter realize.

A recommendation of this thesis is that Lundafastigheter hire an ESCO to conduct a preliminary analysis of their buildings.

A preliminary analysis offers some general predictions on the energy savings potentials, payback times, costs, and length of a potential ESCO project.

Region Skåne is currently in the beginning stages of a possible ESCO project. Region Skåne has a high energy savings potential as demonstrated by the fact that energy savings estimates for this potential project are estimated to be 15% of yearly energy costs, given a 50 million dollar project investment with a seven year payback time. This project, if approved, will help alleviate a number of barriers to greater energy efficiency in Region Skåne's buildings. Region Skåne has a low amount of money allocated for the operation and maintenance of its buildings, has strict regulations regarding their investments, and gives priority to investments in equipment for the organization's core area of medicine over energy or facility related investments. There is a limited capacity by staff to address energy management and to manage projects in energy efficiency.

Energy companies that produce and sell energy directly to customers, such as Lunds Energi, have the potential to gain money from two sides of energy delivery by using the ESCO concept, on the demand-side from shared savings with their customers and on the supply side from possibly decreased costs of expensive marginal fuels and avoided investment costs in new capacity. These demand-side factors can increase the value added of their supply of energy, and these combined demand and supply side factors can improve the environmental profile and general profile of the company. Additionally, there are a number ways that Lunds Energi's might use its core business as a producer and supplier of district heating, and electricity retailer that could provide a strategic advantage in the ESCO.

Unfortunately, on the supply side, Lunds Energi would have to save a very large amount of energy in order to begin to benefit from lower marginal costs of production, and not enough information is known to calculate how much energy would need to be saved in order for them to avoid investment in new generating capacity. One of the greatest barriers for Lunds Energi to adopt an ESCO business model is that customers may doubt that an energy supplier can enter into this business due to its obligations and main core competence as an energy supplier.

It is recommended that Lunds Energi first determine which areas of its present capacities (including those suggested in this thesis) can be used for performance contracting, then test out the use of the ESCO business concept in conjunction with the conversion of one of their customers from oil to district heating.

The energy service company market in Sweden is an emerging one. According to interviews with ESCOs, substantial cost-effective energy savings potentials are common in the Swedish market across different sectors. Energy savings potentials were estimated by Swedish ESCOs and Anti-cimex (a company that as one of its activities conducts building transfers and also sometimes includes energy audits with these building transfers). In all but one case, for newer buildings, savings potentials were generally estimated to be well over 10% of annual energy bills. These numbers are somewhat unclear due to a difficulty in communicating to interviewees what numbers were wanted to answer to this question. ESCOs surveyed generally accepted payback times between five and ten years for installed measures, although one ESCO required a payback time of a maximum of three years.

Given the existence of cost-effective savings potentials, performance contracting can help alleviate planning, financial, technical capacity, and lack of staff or staff availability barriers to energy efficiency within organizations as described above. Barriers for this market in Lund and in Sweden as demonstrated by interviews with real estate actors and Swedish ESCOs and literature are:

Organizational Barriers
Organizations usually give greater focus on their core activities and the associated costs, which may inhibit interest in profitable ESCO projects. Long term will from politicians for energy

efficiency may be difficult to achieve within public organizations given short term political interest.

Financial and Legal Barriers
In Sweden there is a Jordabalken law or "Code of Land Law." This law inhibits companies from taking back items that have been installed in a building that can be considered "part of the building" (IEA 2001). The IEA Demand Side Management Performance Contracting Report for Sweden lists this condition as a general barrier for performance contracting in Sweden. It remains an area of further research to determine how collateral laws could be changed so as to encourage greater financing of ESCO projects by ESCO customers. This could serve to lower the total costs involved in projects and make it financially easier for new ESCOs to enter the market.

The need for public actors to develop solutions around the Swedish law of public procurement may in some cases inhibit these actors from attempting ESCO procurement

Market Barriers
Lack of knowledge by potential customers of the ESCO concept, transactions costs, and perceived risks associated with ESCO projects are all market barriers for greater ESCO procurement. Globally, a barrier for the further development of the ESCO business model and ESCO markets is the difficulty in providing energy services to smaller customers due to high transaction costs and lower potential returns. These barriers were observed in four Swedish ESCOs interviewed who require that customers should have at least 100,000 square meters or have a minimum yearly energy savings potential of 100,000 SEK.

<u>Policies and Actions to Grow and Develop ESCO markets</u>

Promoting a private market tool for energy efficiency, ESCOs, may serve as a way of having a more long term strategy in this market. Based on the research conducted in this thesis, there is no evidence from this research to suggest that there are great barriers for a customer over a certain size with a certain amount of energy savings potential in becoming an ESCO customer in Lund, Sweden. However, a smoother and quicker contract process aided by policy tools and instruments could have made the above process easier for Region Skåne and similar actors.

The development of the ESCO market to include retail energy suppliers as ESCOs and smaller customers as part of the customer base would be two significant steps. This research analyzes the potential for Lunds Energi to become an ESCO. An explorative approach is taken to identify a business model and/or policies that will deliver ESCO services to smaller customers. Although a strict ESCO business concept is not identified, some interesting business models are described, including the potential business opportunity presented by a Swedish auditor, Anti-Cimex. These three cases are used to provide some basic conclusions on what a policy would consist of to further develop an ESCO market to include smaller customers, although no specific policy is identified.

Two steps that can be taken to assist greater growth in the ESCO market in Lund and in Sweden are listed below:

1. The first step toward achieving greater growth of the Lund and Swedish ESCO markets is to increase the knowledge of this business concept. Potential customers cannot hire an ESCO if they have not heard of this concept, or if an inadequate understanding of the concept leads them to not want to pursue it. Increased knowledge dissemination is one of the goals of an initiative in its early stages between STEM and the Southeast Sweden Energy Agency.

2. The second step toward achieving further growth in the ESCO market in Lund and in Sweden is for the creation of standardized performance contracts using successful examples from other countries. Under the current conditions, new solutions have to be worked out each time between the ESCO and its customer. A standardization of ESCO contracts could give these contracts greater credibility and make it easier to compare the services of different ESCOs, and thus make the ESCO business concept gain customers faster and become an easier "sell" for those within real estate organizations to their boards and co-workers

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1 Introduction

1.1 Background

An energy service company (ESCO) is an example of an atypical business model in that it generates positive externalities as its business grows. Externalities are effects that are not taken into account in the price of a good or service.

The basic business concept of an Energy Service Company (ESCO) is a company that installs energy efficiency measures, such as new lighting and ventilation systems, and guarantees the energy savings and/or resulting financial savings as a result of these measures. ESCOs also typically provide or arrange for project investment (Bertoldi 2004). An improvement in energy efficiency can be defined as any action that reduces the energy used per unit of input, without affecting the total level of service provided (ACEEE 2004). Energy savings from the energy efficiency measures are gained over a period of time and are quantified financially according to the details specified in a performance contract. The revenues that an ESCO receives are directly linked with the performance of their implemented energy efficiency measures. Therefore, this concept is sometimes called performance contracting.

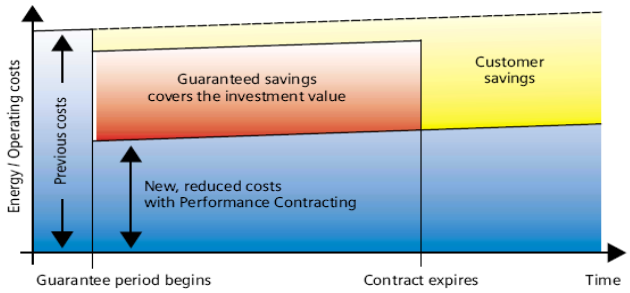

Figure 1-1: Customer's reduction in energy costs through performance contracting
Source: Siemens Website

Energy that is saved by ESCOs or that potentially can be saved by ESCOs does not need to be consumed simply because ESCOs, or the consumer, can make a profit (or reduce costs) from saving this energy. Reduced environmental impacts from energy generation, such as global warming impacts from CO_2 emissions, can be accomplished by using less end use energy. Final energy consumption in buildings is estimated to account for almost 50% of CO_2 emissions throughout Europe (Commission Proposal COM(2001)226 final). Reduced reliance on forms of energy that are produced by foreign sources can keep money within a national or local economy, and reduce the potential for political struggles over energy.

For an organization, a reduction in energy use decreases cost. Additionally, improved lighting, comfort, and reduced noise that can come from energy efficiency retrofits may increase customer and worker satisfaction, and worker productivity (Romm & Browning 1994).

The global ESCO market, and also the ESCO market within Sweden, is much smaller than what might be predicted given the business opportunities for such an actor can from energy savings potentials for existing buildings estimated the original proposal for the European Community on the Directive on energy performance of buildings and other studies. This directive proposal estimates that without reducing comfort or standards of living, it is possible to reduce energy consumption by at least one-fifth at no extra cost, and in many cases at

negative costs because the energy saved is sufficient to recover investment costs and interest rates.

Globally, most ESCOs operate only within their home country (Vine 2003). Some estimates for the number of ESCOs and revenue per year for ESCO markets in different countries are given from Vine (2003) and other sources below:

Country	Number of ESCOs	Total Revenues
Finland	4	$0.5-1 million
Italy	20	Don't Know
Japan (Nakagami 2003)	114	$94 million
Poland	8	$30 million
South Korea (Lee et al 2003)	125	$75.79 million
Sweden	6-12	$30 million
Switzerland	50	$13.5 million
United States (Goldman et. al 2002)	63	$2 billion

Improvements in efficiency can sometimes suffer from the "rebound effect." This means that money saved through energy efficiency in one area may be used to pay for higher energy consumption in another area, higher consumption of the same energy services, and/or on activities that cause environmental impacts not related to energy. The impacts from these rebound activities may negate any net environmental benefits achieved by an actor. This is because these rebound activities can have environmental impacts than are equal or greater to the environmental benefits achieved by reductions in energy use. Energy service companies can be said to negate some of the potential for negative rebound effects in that they absorb some of the savings caused by energy efficiency and spend them on more energy efficiency.

A drawback of the ESCO concept is the focus on a limited[1] number of energy efficiency measures, and the limits of the scope of energy efficiency within broader environmental management. Environmental impacts stem from a wide range of areas such as transportation, energy production, and generation of hazardous waste. These impacts extend throughout the full "life-cycle" of materials; for example from the mining and refining of materials, to the production of products, to the use of these products, and the final disposition of materials, such as landfilling or reuse. For the product of a building, ESCOs only reduce environmental impacts associated with its use, leaving out impacts associated with its production and final disposition. This also leaves out potentially profitable investments for organizations to make that will provide differentiation through an increased environmental profile, and profitable investments that can reduce costs of material and water usage, along with waste disposal costs.

1.2 Research Objective

Despite the current drivers, interest, and financial opportunities that energy efficiency presents there is a lack of implementation globally corresponding to the economic and technical potentials. Some of the reasons for this cited in the proposed EU Directive on energy end-use efficiency and energy services are (Commission Proposal COM(2003)739 final):

- Lack of a harmonized credible framework of instruments, mechanisms, definitions, and information regarding energy efficiency services and measures
- Institutional barriers
- Investments in energy using technology are often in one budget whereas operation and maintenance activities of this technology are put in a separate budget

[1] Only those measures that (although possibly not cost effective individually) are cost-effective within the context of an overall project.

- Uncertainty regarding energy prices and the correlated payback times of investments
- Fragmentation of the energy efficiency market

One method of capturing energy efficiency opportunities and reducing emissions associated with power generation is to use the private sector as a vehicle through the use of ESCOs. ESCOs can enable cost-effective energy efficiency projects to be implemented in their customers' buildings through the package of services they provide. These services can include project investment or arranging for financing, a guarantee on energy savings, technical expertise, project management, and training of a customer's staff. In order to increase procurement of ESCOs, there must not only be customers that can find value in an ESCO's services, but also a sufficient quality and quantity of suppliers, along with market conditions that allow for these suppliers and buyers to interact effectively and efficiently. The policy framework surrounding an ESCO market can significantly aid the procurement of performance contracting by assisting the efforts of potential ESCO customers in making their procurement of performance contracting easier, by assisting potential and existing ESCOs, and/or by aiding the interface between these buyers and sellers. Additionally, policies can help assist the development of ESCO markets to include smaller customers as customers and energy retail suppliers as ESCOs.

Lund was chosen as a location to study the potential for growth and development of an ESCO market because of the current lack of procurement of performance contracting in Lund by potential customers, and the non-existence of ESCO suppliers in Lund. Additionally, Sweden was perceived to have a relatively smaller ESCO market as a whole compared with some countries. This perception came from Vine et al.'s international survey of ESCOs (Vine 2003) and conversations with energy researchers at IIIEE.[2] This relative lack of ESCO procurement in Sweden was viewed as a potential opportunity. Another interesting area of research in Lund is studying the local district heating company, Lunds Energi, for its potential to become an ESCO. There are currently no ESCOs located in Lund. The potential development of a local ESCO is viewed as beneficial and interesting as this would combine the promotion of the local economy with environmental goals. A local actor also may have lower transaction in conducting business with nearby customers, especially existing customers that they already have an established relationship with. Finally, a successful performance contacting business model for Lunds Energi would be an innovative step forward that could expand the thinking of what is possible in today's deregulated Swedish energy market.

The main question of this thesis is:

What is the potential for growth and development of the ESCO market in Lund, Sweden? What actions are needed to realize this potential?

In analyzing the potential and actions cited in this question, this thesis will examine organization (potential ESCO customers and potential ESCOs), market, financial and legal, and policy perspectives. The word growth here means the absolute increase in the number of ESCO projects and total market size (revenues) of all ESCO projects combined. According to economist Herman Daly, to develop means "to expand or realize the potentialities of; to bring gradually to a fuller, greater or better state (Hawken 1993, p.140)." Two areas of the development of the ESCO business concept that this thesis addresses are the development of the ESCO market to include energy suppliers as ESCOs and smaller customers as ESCO customers.

[2] Tomas Kåberger and Lena Neij (IIIEE). Personal Communication.

In order to attempt to answer this question this thesis has one primary objective and one sub-objective.

The primary objective of this thesis is:

To assess the potential for three Lund real estate organizations to become ESCO customers and one Lund energy supplier to become an ESCO

A sub-objective of this thesis is:

To identify and analyze existing and potential polices that may be used to aid the growth and development of an ESCO market in Lund

Lund can be considered a fairly unique area of study given the large role that the University plays in this town. On the other hand, there are aspects about Lund and its building market that are similar to the rest of Sweden. One common aspect that Lund shares with the rest of Sweden is in the structure and identity of some of its real estate organizations. The three real estate actors in this study are Akademiska Hus i Lund, Lundafastigheter, and Region Skåne. They are all real estate organizations that rent out to government or university (which is largely funded by the government) tenants. Akademiska Hus rents i Lund rents out to Lund University. Lundafastigheter rents out buildings to Lund municipality. Region Skåne rents out to tenants that mainly encompass the health care system (also dental care, culture and regional development, including regional public transportation). Two of these organizations, Region Skåne and Akademiska Hus, are national organizations with Lund as one of their multiple locations. Finally, one more commonality between Lund and the rest of Sweden is that the Lund building market is affected by larger legislative actions within the EU and Sweden.

1.3 Scope

The primary geographic focus of this thesis in Lund, however, the scope also extends to broader Swedish conditions. Global case studies and literature will be discussed when relevant.

The three Lund real estate actors chosen for this study were selected for two reasons. First, public actors can make good ESCO customers because they typically have longer planning, can attract third party financing at more attractive interest rates, and are better able to deal with longer payback times (Goldman et al. 2002). Secondly, all three of these real estate actors are district heating customers of Lunds Energi, which is evaluated in this research as a potential ESCO.

ESCOs generally focus on energy efficiency in existing buildings, thus leaving out a broader agenda for sustainability in society as a whole regarding existing buildings. New building construction offers far greater potential energy savings over improvements that can be made to existing buildings in Sweden and elsewhere. New building construction, however, is relatively small compared with the large existing building market in Sweden. At the present rate of demolition approximately 75% of today's Swedish building stock will still be in use by 2050 (Neij & Ofverholm 2001).

Some examples of other factors associated with buildings that can reduce or increase environmental impacts left out by the ESCO business concept are listed below as contained in the United States Leadership in Energy and Environmental Design (LEED) pilot standard for environmental performance and sustainability in existing buildings (this document does not address the ESCO business):

- The type of power bought to serve the building or produced on-site
- Use of materials in housekeeping
- The use of local or non-local materials
- Use of site area (e.g. keeping or developing greenspace)

The scope of this thesis is on cost effective energy efficiency implementation using existing technology. Technological advances and the market deployment of these advances for increased energy efficiency are considered outside the scope of thesis research. Finally, the scope of this paper will include water savings and water savings potentials in existing buildings as some ESCOs conduct these measures, although this will not be an area of emphasis.

1.4 Limitations

Providing a case study approach of four actors leaves out a broader viewpoint on an ESCO market or potential ESCO market. The author's lack of knowledge of the Swedish language has limited access to information in some cases. Additionally, interviewees are representatives of their organizations not representing a large sample size, and may have had biases and/or information gaps when presenting information.

1.5 Methodology

This research is an exploratory study that follows a qualitative approach. An exploratory approach was chosen as this research required an evolving development in understanding of the ESCO business concept, and an on-going search for information in a number of areas such the four case studies, the current state of the Lund and Swedish ESCO market, and possible business models both for district heating companies as ESCOs, and for ESCOs to serve smaller customers. An interest in the research area of ESCOs led the author to first look for actors that might be willing to participate in this study. The decision to focus on Lund began with the cooperation of Lunds Energi, the local utility, in this study.

Information for this thesis comes from two main sources: thirty-two interviews with relevant organizations, and a literature review. Semi-structured interviews were done in person and by telephone, with additional written material, sometimes supplied by interviewees. A complete list of interviewees and a list of typical questions asked to interviewees are available in the appendix. Secondly, information comes from a literature review of ESCOs. Due to time limitations, less extensive searches were conducted on the topics of the Swedish experience with energy efficiency, real-time electricity pricing, energy efficiency within organizations, and smaller customers and energy efficiency. Interviews with Swedish ESCOs may in some cases more clearly reflect the Swedish experience and are thus relied upon to fill in knowledge gaps from the literature review.

A few ESCO models are presented in this paper for contracts, financing, and installed measures. It is important to understand that the ESCO business and energy service contracts are a dynamic process so that the models are only examples. On this note, *it is also important to realize that the valuation criteria identified in Section 2 are intended to provide the reader a better understanding of the barriers and opportunities facing potential ESCOs and potential ESCO customers, and are not rules "set in stone."*

In order to evaluate the potential for three Lund real estate actors and one Lund energy supplier to become ESCO customers and an ESCO respectively, then evaluation criteria must be used to evaluate these two perspectives:

- The potential ESCO customer perspective – What factors make up a potential suitable, or ideal, ESCO customer?

- The potential ESCO perspective – What does an actor need to succeed in the ESCO business?

These evaluation criteria are determined by reviewing five critical areas of the ESCO business concept using a literature review and interviews with Swedish ESCOs. These critical areas are:

1. Staff Capacities
2. Energy Savings Potential
3. Financing
4. Planned Effective Partnership
5. Size

There are two different viewpoints in this paper, the perspective of the success of individual ESCO projects and that of ESCO markets as a whole. Evaluation criteria are used to assess three potential ESCO customers and one potential ESCO for their ability to become, individually, ESCO customers and ESCOs respectively.

The observations and conclusions from this analysis and a literature review are used in the subsequent analysis of a potential ESCO market as a whole in Lund and Sweden to answer the second research question of "what actions need to be taken?" to realize the potential of the ESCO market in Lund. First, important factors are identified that are influencing the Swedish ESCO markets are identified from market, financial and legal, and organizational perspectives. Market conditions are those that affect the interface between buyers and sellers are organizational conditions are those that are handled internally within an organization. A flexible view is taken on what is considered internal to an organization with the assumption that given a certain business concept, organizations can often influence and change the surrounding market conditions to their advantage.

2 The ESCO Business Concept – Evaluation Criteria

Section 2 will develop evaluation criteria to be used on a potential Lund ESCO and potential ESCO customers in the following section 3. The development of these criteria begins in section 2.2.

Section 2.1 provides a further description to the reader on the ESCO business model by describing how an ESCO project might work. Representatives from four Swedish ESCOs and the Southeast Sweden Energy Agency were asked "What resources would a company need to start an ESCO, and what are the related resources needed for the implementation of ESCO projects?" Interview respondents often provided a simpler picture of how their ESCO businesses operated than found in the literature review, which primarily came from US authors drawing on the US experience. For example, literature described measuring the energy output of individual lighting equipment to conduct monitoring and verification of energy savings, while representatives from the four Swedish ESCOs interviewed stated that they usually relied on more simple methods, such as reading heat and electricity meters within buildings and monitoring the outside temperature. There is a limited amount of literature written in Sweden on the subject of ESCOs to draw from.

2.1 How an ESCO Project Works

This section 2.1 will provide a basic introduction to the ESCO business concept building on the short description provided in the background section (Section 1.1).

ESCOs fall under the general category of providers of energy efficiency services, which can be defined as services related to the end-use of energy where profits are made[3], but not necessarily tied directly to an improvement in energy efficiency (Wuppertal Institute 2003). There are three main differences between ESCOs and other providers of energy efficiency services. These differences are that ESCOs 1) usually provide for or arrange for project investment 2) place a guarantee on energy savings and; 3) have their revenues directly tied to the performance of their energy efficiency measures (Bertoldi 2004). Additionally, ESCOs often provide training for their customers in the operation and maintenance of both equipment installed as a part of the ESCO project (World Bank 1999), and also possibly extending into broader areas of the facility as a whole. This training serves the ESCO's interest in that it lowers the performance risk that the customer will inadequately operate and maintain their facilities during the length of a project, and raises the potential for greater returns to be gained by improved facility operation and maintenance.

Figure 1-4 provides an illustration of the typical stages in an ESCO project as illustrated on Siemens' website. When prospecting for projects with potential customers an ESCO must first make a preliminary study to determine whether potential customers have the energy savings potential necessary to make a profitable project. This can be accomplished using methods such as walk through audits of the potential customer's facilities and/or examining the potential customer's past utility bills. One way of analyzing these bills is to compare the electricity and/or heat consumption with the typical consumption in the relevant building sector.

[3] For example, profits cannot originate from sources such as the sale of energy or an "innovative marketing schemes" (Wuppertal Institute 2003).

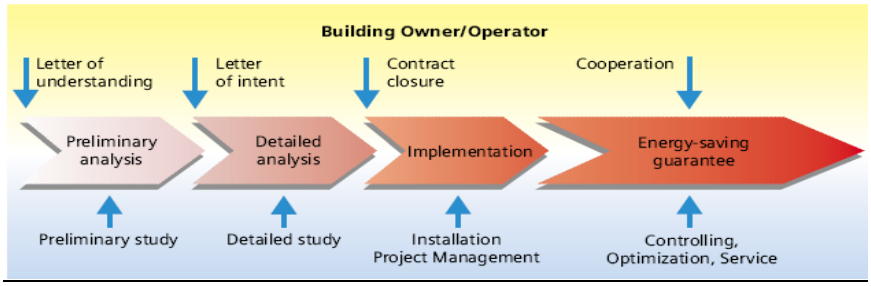

Figure 2-1: Value Chain for Siemens Consulting
Source: Siemens Consulting Website[4]

If the customer agrees to go ahead with the project, then a further analysis is conducted of the customer's energy use in order to predict the energy savings that the ESCO will guarantee. Project development may include the design and management of construction and engineering (Westling 2003), along with the hiring and management of subcontractors. Additionally, an ESCO conducts monitoring and verification to insure that the energy savings from these measures have occurred, which may include the installation of new monitoring systems (Westling 2003).

Box 2.1 How a Typical Siemens Performance Contract works (Source: Frank Johansson. Personal Interview)

To take a closer look at how this works a typical Siemens contract will be broken down in stages. First, a letter of understanding is signed by the potential customer that Siemens has permission to walk through their facilities, read some of their documents, etc. The preliminary analysis takes about 6 days, with half of this time on-site and the other half analyzing this information. After this time Siemens makes an initial offer. This contains some general predictions on energy savings potentials, payback times, costs, and length of the project. At this point the customer chooses whether to accept then they sign a letter of intent. In this letter of intent agrees, the customer agrees that they will employee Siemens for a contract if Siemens is able to give a similar offer to their initial one after they conduct a more detailed analysis, which usually takes approximately 2 months. During this time Siemens looks more deeply into the customer's energy consumption patterns. Tenders are also put out for subcontractors, electricians, HVAC specialists, etc. These subcontractors are hired on the basis of the function they can provide, not on specific services. For example, if 100,000 m^3 of air is needed over three areas at a temperature of 21 degrees Siemens does not specify how the contractor should do this; rather they simply specify certain performance and cost requirements. The next step is the installation of the equipment by Siemens and their subcontractors, typically lasting approximately 6 months. This period can be regarded as a period of "free" energy savings for the customer since all energy savings gained from equipment before the official start of the energy savings guarantee period goes to the customer. The final stage of Siemens's performance contracts are the energy savings guarantee stage typically lasting 5-10 years.[1]

Savings guaranteed by Siemens are equal to the payment for these rental contracts. Savings that go beyond the guaranteed savings are typically split 50\50 by Siemens and the customer. It is not until the savings guarantee stage that the customer gives any payment to Siemens! In the case of Siemens, the time leading up to this first payment can sometimes last one year. The customer pays Siemens through their energy savings. Siemens calculates the contracts so that the savings guarantees equal the energy savings gained by customers.

[4] Siemens Building Technologies: [Online]. Available: http://www.landisstaefa.com/sol/e/dow/performance_contracting/0-91841_en.pdf [2004, June 15]

Monitoring and verification of energy savings is necessary to show that these savings have actually occurred as promised in performance guarantees. In order to accomplish this guarantee an ESCO must first set a baseline energy use by the customer than then monitor and verify that energy savings have occurred with reference to this baseline condition. Monitoring and verification is usually used as one term, however, the International Performance Measurement and Verification Protocol (IPMVP), an NGO that writes an updated standardized monitoring and verification of energy savings protocol, defines monitoring as the collection of data over a period of time at a facility in order to be used to analyze the facility's potential energy savings (IPMVP 2002). According to Waltz (2003), verification stands for the part of an ESCO's project where the ESCO checks to see that the systems installed by the ESCO and their subcontractors are working according to specification, that the proper equipment has been installed, and that equipment continues to perform as intended throughout the entire period of the contract (Waltz 2003). Together, monitoring and verification can serve as a "strong diagnostic tool" to maintain past energy savings and identify new energy savings opportunities (IPMVP 2002). This added monitoring of systems may also improve the total operation of a system's engineering beyond simply achieving greater energy efficiency (IPMVP 2002).

The direct financial savings from saving energy generally come two parts of energy bills, the charges for capacity and those for energy use. Capacity charges are based on peak demand of the facility in question or the average peak demand over time. These charges can change if a facility changes its profile but can otherwise be considered fixed charges. The actual energy used by a facility is the variable charge of the contract. This is the amount of energy used multiplied by time. When calculating energy savings one has to take into account both the reductions in kilowatt hours consumed and any changes in the profile of a building.[5]

Monitoring and verification can be conducted in a number of ways. The interaction between a building, cooling and heating, its occupants, and the weather make up a complex system (Waltz 2003). This is why it is useful to gather time-series data, as monitoring at any one point in time will not be able to begin to paint this complex picture. Some methods of monitoring and verifying energy savings include temperature sensors, electricity and heat meters, building automations systems, sensors connected to power loads, computer simulations, automotive or other measures to measure building occupancy, and the estimation of outside temperature either through degree day data bought from another source or measures directly. Assumptions or stipulations for energy conservation measures can be determined without actual monitoring through computer simulations or more simplistic methods. For example, if it is known that one light bulb generally uses 50% less energy than another light bulb then this can be assumed to reflect the actual performance of these light bulbs.[6]

The general equation for determining energy savings is (IPMVP 2002):

The savings from energy efficient measures = Baseline Energy Use – Post-Installation Energy Use ± Adjustments

[5] As described by IIIEE professor Åke Thidell

[6] This brief list is arrived upon from Waltz (2003), (IMPVP 2002), and interviews with Swedish ESCOs. For a more thorough description in of monitoring and verification, along with a classification of different methods, one can read the International Performance Measurement and Verification Protocol (IPMVP). Concepts and Options for Determining Water and Energy Savings, Volume 1. [Online]. Available: http://www.ipmvp.org/ [2004, September 22]

An ESCO normally calculates their customer's baseline energy by first taking past energy usage information either from bills or from meters. This baseline is then put into an algorithm with variables such as degree days[7], the cost of electricity, the cost of heating, and building occupancy. The word adjustment in this equation refers to the adjustment of the base periods to reflect changing conditions during the contract period (IPMVP 2002). Some of these changing conditions may be weather, occupancy, expansion of a facility, or changes in production (industrial case). The conditions that are set for the base use in a contract can be regarded as a shifting of risk to either the ESCO or the client. For example, if a base condition of an assumed 10% occupancy is given then this puts risk on the ESCO. If this building has a greater occupancy then the ESCO has to demonstrate this and renegotiate the risk, or else they will not be able to achieve their guaranteed savings. Occupancy of 100% would put no risk on the ESCO in regard to this variable. An important variable to take into account is energy prices. Both customer and ESCO benefit, for example, in the current Swedish energy market trend of rising energy prices when an ESCO contract sets energy prices at a fixed rate in the baseline energy use condition. This gives the customer the chance to profit from rising energy prices and the ESCO the benefit of lowering their risk from a sudden drop in energy prices.[8]

One of the unique aspects of ESCO projects when compared with traditional energy service providers is their ability to provide project investment and/or arrange for this investment. The performance risk of achieving the guaranteed savings is borne by the ESCO. Assistance with financing of projects by ESCOs is a practical way for organizations to alleviate internal barriers to financing energy efficiency improvements. In a global context, the two most common types of financing for ESCO projects are guaranteed savings and shared savings (WEEA 1995). In guaranteed savings contracts the client assumes the credit risk while ESCOs assume the performance risk for energy savings, keeping the ESCO's balance sheet free of debt. Although ESCOs typically arrange this financing, they have no direct contractual relationship with the third party financier. If energy savings are not met then the ESCO pays the customer the difference between guaranteed and actual savings (WEEA 1995). In the US case, an advantage of having the customer take out the loan is that the cost of capital for an ESCO customer is almost always cheaper than for the ESCO (World Bank 1999). This condition was confirmed in interviews with Swedish ESCOs. One ESCO employee estimated that it cost their municipal customers an interest rate of 1.5% by having the ESCO take out a loan rather than the customer.

[7] Degree days measure the heating or cooling load put on a building by the outside temperature. A heating degree day occurs when the outside temperature is below a certain reference temperature, with the opposite true for a cooling degree day. The number of degrees difference below this reference temperature for a given day counts for that number of "degree days" for that day. For example, if the temperature were to stay at a constant 12 degrees below the reference temperature for heating degree days for 10 days, then this would count for 120 heating degree days (IPMVP 2002).

[8] Examples based on personal correspondence with Vladimir Dobes, Project Manager for the EMPRESS Project and IIIEE professor

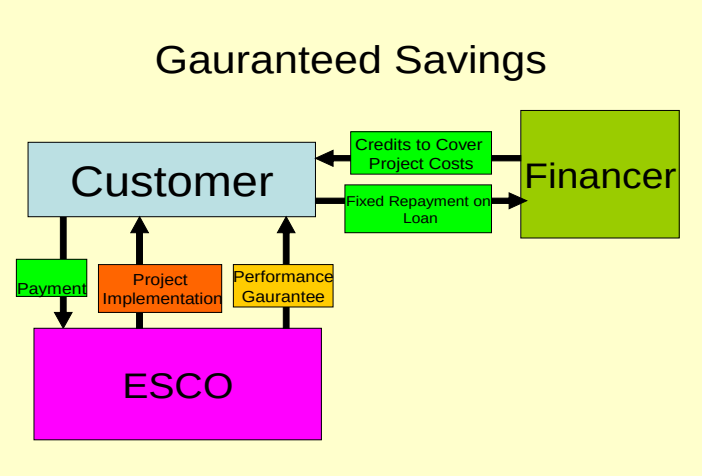

Figure 2-2: Guaranteed Savings Project Financing
Source: Manuel Swärd, Southeast Sweden Energy Agency

A second kind of ESCO financing is shared savings. In this case ESCOs assume the project performance and credit risk, either going through a third party to gain funds or using their own funds. This arrangement may be beneficial to customers as they do not have to provide investment (WEEA 1995). This type of financing gives ESCOs a larger risk since they are bearing both performance and credit risks, which may lead them to raise their requirements for their return on investment to account for this risk (World Bank 1999).

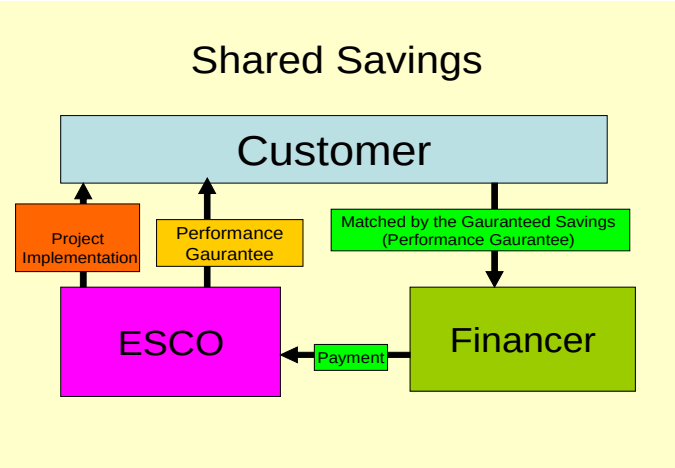

Figure 2-3: Shared Savings Project Financing
Source: Manuel Swärd, Southeast Sweden Energy Agency

A general issue with ESCO financing is collateral. This poses an obvious predicament since according to the World Bank (1999) the potential for reuse or salvage value of the equipment that an ESCO installs "is limited and tends to be significantly lower than the debt outstanding at any given time." Two ways to provide collateral in ESCO projects are: 1) project assets such as revenues of a project or the installed equipment, or 2) assets of customers and/or ESCOs. Collateral from project assets can be obtained through (other than equipment) the rights to the contract between the ESCO and their customer that specifies that an ESCO will receive a certain portion of the shared financial savings from reductions in energy use (World Bank 1999). Financial institutions may view project assets as a riskier form of collateral than assets of customers and/or ESCOs. Project assets can be viewed by financial institutions to be especially risky when the credit and performance risk are both held by the ESCO (shared savings), causing them to charge higher interest rates (World Bank 1999). With both project

based and asset based collateral, a financial institution's impression of the ESCO industry in general and/or the ESCO in the project will also be a factor in determining their perceived risk in financing, and thus the project involvement or interest rate that is given, especially in the case of shared savings.

The figure below illustrates an ESCO's projects costs, along with some estimation of their distribution, as estimated by Easton Consultants and taken from a presentation by Charles Goldman of the US Berkeley National Laboratory. Prospecting/proposal general and project identification can be considered transactions costs. Transaction costs as defined by Coase are simply "the resources that have to be used to carry out a market transaction" (Ostertag 1999), such as negotiating agreements, evaluating potential suppliers or buyers, and gathering information on technologies and their suppliers. Transaction costs not shown below are the project negotiation (between client and ESCO and ESCO and subcontractors) and gathering of information on suitable technologies and sub-contractors (Ostertag 1999). Although monitoring and verification and verification of projects was described by Goldman (2003) and others (Ostertag 1999) as part of transaction costs, this research will regard monitoring and verification as part of the operating costs since they occur after the customer and ESCO have reached agreement on a project. Design and capital equipment and installation can be regarded as project investment.

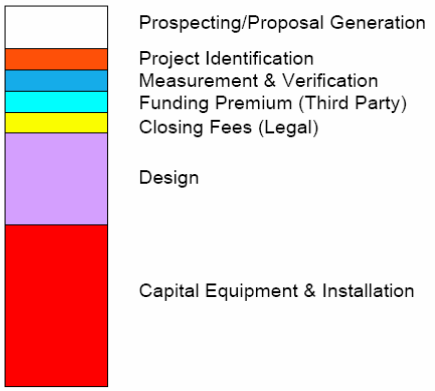

Figure 2-4: Illustration of Performance Contracting
Source: Presentation by Charles Goldman (2003), Lawrence Berkeley National Laboratory.
Primary Source: Easton Consultants

The energy efficiency measures that ESCOs and their subcontractors implement may involve adjustments to their customers' existing building systems and equipment, and/or the installation of new building systems and equipment. The word equipment here is used in reference to singular items such as windows. The word system here indicates a broader network of interrelated equipment such as a heating ventilation and air conditioning system (HVAC), although this distinction may be blurred. Paolo Bertoldi of the EU Joint Research Commission (2003) gives the following list below as typical projects implemented by ESCOs in Europe:

- Operation of building heating
- Installation and operation of combined heat and power plants
- Industrial facility refurbishment and operation
- Building facility management
- Public lighting refurbishment operation

Bertoldi (2003) writes that more recently some European ESCOs have been installing lighting, heating, ventilation, and air-conditioning, energy management systems, and variable speed drives for motors.

To provide an example of measures implemented by a Swedish ESCO, the most commonly installed measures given by YIT for their ESCO business in Sweden are listed below.[9]

1. New building automation systems
2. Heat Recovery Systems
3. To control the operating time for Heating Ventilation and Air Conditioning systems, close or reduce the airflow, temperature, etc.
4. Adjustment of airflow and temperature

In the case of Siemens and TAC, projects were reported to often incorporate measures with longer payback times such as installing new windows, or measures that incorporate the more complete modernization of facilities.[10] Customers are presented with these additional options and given the choice of adding them onto a project.

Together, management (including behavioural measures), adjustments to existing capital, and investments in new capital, along with monitoring and verification of energy use and savings all make up what is known as energy management. According to O'Callaghan (1993, p.30), energy management can be defined as:

Energy management is a technical and management function the remit of which is to monitor, record, analyze, critically examine, alter and control energy flows through systems so that energy is utilized with maximum efficiency.

ESCOs provide an outsourcing of some of the energy management functions within organizations. Many aspects of energy use can be considered inherent to a building's characteristics, such as it building envelope. The building envelope is the "external skeleton of a building", including the walls, windows, floor, doors, foundation, etc. The building envelope determines a great deal of the heating and cooling loads of a building (Heng 2003). Additionally, other energy consuming areas such as ventilation or security lighting can also be considered part of the "base" energy use of a building, or in other words, the energy use necessary for the functioning of the building. Energy consumption outside of this base use can be attributed to the user.

Reductions in energy use of buildings can be accomplished through capital investments, such as an investment in a new ventilation system that can lead to energy savings; behavior of building occupants, such as turning off equipment at night and whether a building is occupied or not most of the time; and improvements in the operation and maintenance of a facility (Heng 2003). While behavior changes and operation and maintenance changes may be less certain than capital investments, one scenario given by the Wuppertal Institute (2003) is that these measures often experience investment (e.g. education) payback times within months, whereas capital investments may take years to pay back. Building automation, a capital investment, can provide a link between these two categories as it can be used to shut off

[9] An obvious difference between Sweden and warmer countries is the cost savings and related emphasis put on measures related to a heating system versus those in a cooling system. For example, lighting measures do not have the added benefit in Sweden of serving to reduce air conditioning bills by reducing heat, although this would be an important factor, for example, in the southwestern US (Manuel Swärd. Personal Interview).

[10] Frank Johansson. Jonas Tegström. Personal Interviews.

automatically when users leave an area. In any case, however, some aspects of a building's use can always be attributed to its users.

2.2 Staff Capacities

The ESCO business requires a mixture of staff capacities in social skills, technical skills, project management, and legal knowledge. The breadth of capacities needed by an ESCO staff makes sense when one considers the problem that this business concept addresses barriers to energy efficiency. These barriers reflect all of these dimensions. Specific potential ESCO customer staff requirements are not provided here, however, general requirements for the profile and commitment of the potential ESCO customer organization are given in section 2.4 and 2.5.

Project Manager

According to Hansen and Weismen (1998), an ESCO's project manager plays a pivotal role in projects. Project managers must be salesman but they must also help out in other areas such as buying and managing subcontractors help with risk assessment. A project manager can help with the risk assessment, determine customer needs, and "merge ESCO and owner staff into one team, and become a link between ESCO and owner management" (Hansen & Weismen 1998, p. 74).

Legal Competence

One of the preconditions to be successful in the ESCO business is to have legal competence in order to protect for customer changes in customers' operation of facilities, weather, energy prices, and other factors. A number of ESCOs in Sweden in the 1980s failed to adequately protect themselves in their contracts in the case of falling energy prices causing some of these ESCOs to go bankrupt. This gave the industry a "tarnished reputation" in Sweden (IEA 2001).

Social Skills

Technical abilities of energy professionals can be of much less importance than social factors involved in their interactions with their customers. James Brown of the US ESCO ESA Energy Associates states in the field of energy professionals "our most costly departure from reality has been that we continually break the most basic rules of communication." For example, Mr. Brown cites an example where a company overestimated the savings a project would gain because they communicated with the wrong people in the wrong way. Issues were discussed with actors such as a school principal and not the most knowledgeable and active person concerning energy issues in the building, the janitor, leading to a 22% overestimation of energy savings[11] (Brown 2003).

A more integrated approach toward energy services leads an ESCO to ask more socially orientated questions. According to Brown (2003), some examples of these kinds of questions are:

*Can the staff operate the system an ESCO is thinking of installing? For example, does a computerized energy control system fit the staff capacity, wants, and needs? Why is the current system the way it is? What are the future plans for the facility? How can a retrofit complement [*future plans and goals*]?*

[11] The miscalculations were made on how long the lights were left on each day and to the wattage of light bulbs.

Additional "essential skills for operating an ESCO," according to Dr. Hameed G. Nezhad in his survey of the ESCO industry in Asia (2004) are: 1) *Economics, finance, and accounting* 2.*Training* 3.*Knowledge of government policies* 4) *Negotiation and conflict resolution skills* 5) *Energy system management, design and specification, operation and maintenance, and evaluation.*[12] These essential skills fit the already provided description of how ESCO projects work (Section 2.1). For example, negotiation and conflict resolution skills may be needed to manage the operations risk in projects, the risk that changes in customer operations negatively affect the project outcome (Nezhad 2004). These skills are needed to first preventatively negotiate a base-line condition of energy use and operations that will minimize this risk before a project begins, as already described (Section 2.1). Subsequently, negotiation and conflicts resolution skills will be needed if the project does not go according to the plan set in the contract.

Interviews

An interview with Frank Johansson from Siemens provided additional insights on what may be required of an ESCO's staff. According to Mr. Johansson at Siemens an ESCO must have energy engineers, but these engineers can be used for multiple purposes other than just a company's ESCO business.[13] Energy engineers are needed to implement the above measures and for areas such as conducting monitoring and verification of energy savings. According to Mr. Johansson, ESCOs also must have salespeople solely dedicated to performance contracting. Mr. Johansson states that a precondition to be a successful is that an ESCO must have tools in order to conduct their business, such as tools to communicate with the customer and calculate the customer's costs:[14]

The potential ESCO perspective – Staff Capacities

- Project Managers with the ability to manage subcontractors, and salespeople that are dedicated to only performance contracting
- Energy Engineers – they can also do other jobs other than performance contracting
- Employees with social skills (including negotiation and conflict resolution, and training skills)

This is of course an area that is hard to quantify, however, some examples of the types of social challenges and situations an ESCO employee may face during a project are given in this section.

- Legal Competence
- Tools, and skills in economics, finance, accounting
- An ESCO must have the necessary technical competence

Some key issues of ESCO technical competence are energy system management, design and specification, operation and maintenance and evaluation. A key issue in all ESCO projects is the monitoring and verification of energy savings. An ESCO may rely on their subcontractors for some of the technical competence involved in a project.

The potential ESCO customer perspective – Staff Capacities

- The customer must have a relatively lower non-financial capacity (e.g. staff and technical expertise) than the ESCO in implementing an energy efficiency project that is significant enough to demand the ESCO's services.

Nazhed's (2004) "essential ESCO skill" of knowledge of government policies is left out as an evaluation criteria because although useful, knowledge of government policies may not be

[12] Items listed in #5 are listed by Nezhad separately, but they are listed together as a unit here for brevity

[13] Frank Johansson. Personal Interview.

[14] Frank Johansson. Personal Interview.

essential, as demonstrated by the only one of four Swedish ESCOs interviewed used government incentives (Section 7.2).

2.3 Energy Savings Potential

An ESCO will not undergo a project if its expected revenues cannot generate a profit over its expected costs. This ability to make money from a project depends on the ability to save a certain percentage of a total energy bill. This savings potential can be seen as one criterion by ESCOs for project involvement. One way for an ESCO to estimate the energy savings potentials of a potential customer is to look at this customer's energy profile. One way to do this is to compare their potential customer's energy consumption per square meter with other buildings in the same sector, which allows an initial assessment of the building's potential energy savings. Of course, since buildings may have varying physical characteristics and varying degrees of use by their occupants, such estimations are only preliminary.[15]

Interviews

An example of how the requirement of a certain energy savings potential may work can be shown by the example of a Swedish ESCO interviewed. This ESCO "strongly considers" leaving a project when a customer's estimated energy savings potentials in the initial audit or "preliminary study" (figure 2-2) are around 10% of their energy bill.[16] Approximately two out of every ten potential contracts of this ESCO are turned down due to low energy savings potentials.

Some estimation for energy savings potentials within different building sectors in Sweden are given by literature and Swedish ESCOs interviewed in this study in section 5.1.

The Potential ESCO customer perspective – Energy Savings Potential

- An ESCO customer must have at least a minimum energy savings potential as a percentage of their total energy bill

The potential ESCO perspective – Energy Savings Potential

- An ESCO must have a market of a critical mass of potential projects with over a certain amount of energy savings potentials as a percentage of potential customers' total energy bills

2.4 Financing

The credit worthiness[17] of potential ESCO customers is important, especially in the case of guaranteed savings when the ability for this customer to take out a loan, along with the interest rate they receive on this loan depends on their credit rating. Additionally, according to the World Bank (1999), the certainty of an organization's future, especially related to the future of the buildings involved a potential ESCO project is a critical factor for ESCOs in determining whether or not to take on a project. ESCOs view projects as risks when they are expected to be unpredictably adjusted or stopped, or unexpected changes occur in factors such as an organization's ownership (World Bank 1999). According to Hansen et al. (1996), especially good candidates for ESCO projects are those that are very credit worthy yet cash poor, as is

[15] Performance Contracting: This is how it works! Siemens Building Technologies. Landis & Staefa Division.

[16] A non-financial reason for why this ESCO leaves projects with 5% or lower savings potentials is that the margin of error on monitoring and verification starts to become closer to the actual savings.

[17] According to Golove (1996), credit worthiness is estimated based on a number of criteria: past debt repayment history, current assets and debts, revenue, investment and purchase patterns, and net cash-flow.

often the case with school districts (Hansen et. al 1996, p. 70), which can also be seen as organizations with more certain futures and that are less mobile.

Interviews

Siemens employee Frank Johansson stated ESCOs should be aware of a company's profile for a number of reasons. A company with poor credit might leave the ESCO with a stranded investment. In many instance instances performance contracting is simply not appropriate because a company already has the internal capacity to make energy efficiency improvements, to optimize their facility, and to finance energy efficiency improvements. Mr. Johansson stated that very large customers with their own engineers and without a lack of financing such as big industries or hospitals may not be suited for receiving an ESCO's services as they can often conduct these services themselves.[18]

On the other hand, according to Vladimir Dobes, a project manager for the EMPRESS monitoring and targeting project in the Czech Republic, in his experience large manufacturers often have energy savings potentials beyond the investment criteria within their organization to make business interesting for an ESCO. One way of achieving this goal is through the use of a monitoring and targeting ESCO concept, which is generally used in on customers with high intensive energy use such as industry or hospitals. In a monitoring and targeting ESCO project the ESCO invests in monitoring and verification equipment. This equipment is typically able to pay for itself within one year of installation as new energy efficiency opportunities are recognized due to the equipment. The equipment also provides a feasibility study for a second contract to be taken, this time a more typical performance contract.[19] This model of an ESCO contract is given to show how savings potentials and estimated payback times of investments might change given the involvement of an ESCO, and possibly even more so given the involvement of an ESCO with an innovative business concept.

The potential ESCO customer perspective - Financing

- The potential customer should have significant possible energy efficiency investments with payback times that an ESCO would be willing to take, but that are too long to meet the organization's internal investment criteria.
- The potential customer does must have a good credit rating and stable and good general profile.

The potential ESCO perspective - Financing

- In the case of barriers for ESCO customers of providing project investment, an ESCO must have the ability to invest in its own projects. In the case that it is financing its own projects it would be beneficial if the ESCO is able to gain low interest rates.

This evaluation criteria comes from the Swedish experience where in the ESCO typically provides project investment. An "if" is attached to this evaluation criterion because it is uncertain whether an ESCO could succeed in Sweden with the customer providing project investment. As already stated in section 2.1., if an ESCO is the one providing project investment through a bank loan, then the banks perceived risk with this loan will be a crucial factor in determining the interest rate. This issue is further discussed in section 5.2.1

[18] Frank Johansson. Personal Interview.

[19] Vladimir Dobes. Personal Correspondence.

2.5 Planned Effective Partnership

Hansen and Weismen (2003) give three key factors for the project management success of an ESCO project: "a planned effective partnership", maintenance and operation of facilities, and the critical role of the project manager in bringing everything together. The first two of these factors will be discussed here. Hansen & Weismen (2003) write that openness with regard to problems and the continual development and review of communication strategies serve to help "a sense of camaraderie" and in to assist in both sides identifying further solutions that are in line with the customer's current operations.

Since the successful energy savings from capital investments in an ESCO project can be dependent on how facilities are operated and maintained during the project period (Hansen & Weismen 2003), then effective partnership between an ESCO and their customer can serve to minimize risks on both sides. A better communication by the customer with the ESCO can serve to lower the customer's risk that the ESCO will implement measures that will disturb their operations. A better communication by the ESCO with their customer can serve to lower their risk that the customer will jeopardize energy savings by operating and maintaining their facility, including new installations, in an inadequate fashion.

Ramesohl et. al (2001) observe that the essential issue in their research was that customers lacked sufficient information and skills to evaluate if ESCOs were providing an accurate analysis and optimal strategy and have little tools for evaluating the ESCO's conclusions. Ramesohl et. al (2001) write that this is an example of information asymmetry, when one party in a contract has greater access to information and ability to evaluate this information that the other party does not have. Because of this condition, the customer has the risk that an ESCO will take advantage of their lack of knowledge in a number of ways, such as in underestimating the level of energy savings potential so as to gain a greater share of the shared financial savings from reductions in energy use. An ESCO that develops a trustworthy reputation will serve to minimize some of this risk, which will lead to more profitable projects. According to Waltz (2003), monitoring and verification is least costly when the exchange of information between the customer and ESCO is accomplished fluidly.[20]

Potential customers will be wary of an ESCO that they believe cannot offer them the ability to provide them with this needed partnership and flexible solutions, and are not believed to be trustworthy. This explains some of the reasons why trust in ESCO suppliers is often regarded as an important factor in the development of ESCO markets (Vine 2003). Since ESCOs also minimize their risk through gaining an effective partnership, they also have reason to be wary of potential customers that are perceived as not being able to carry out such partnership.

Interviews

According to Frank Johansson from Siemens, a poorly functioning organization poses as a risk for an ESCO. It is also possible for an ESCO to be used as a scapegoat when things go wrong within this organization.[21] On the positive side, according to Manuel Swärd at the Southeast Sweden Energy Agency, one of the aspects of an ideal customer for an ESCO is one that has a real interest in developing their own staff.[22] This is because this type of

[20] Bullock et al. (2001) write in A Guide to Energy Service Companies that US ESCOs generally spend US$0.01 to $.03 per square meter, or 5 to 10% of the overall project costs on monitoring and verification.

[21] Manual Swärd. Personal Interview.

[22] Manuel Swärd. Personal Interview.

customer will more likely see and take advantage of opportunities in an ESCO project for the development of its staff, such as an ESCO's training services.[23]

Wolfgang Irrek, presently a researcher in energy efficiency at the Wuppertal Institute, wrote a masters thesis on the ESCO market in Germany. Mr. Irrek observed in a telephone conversation that in his interviews with German ESCOs and their customers that trust ended up being one of the most important factors in ESCO projects.

The potential ESCO customer perspective – Planned Effective Partnership

- Trust in the ESCO from potential customers is very important.
- The organization should be one that is interested in developing its own staff.

For example, customers must be able to trust that an ESCO has the competence to conduct projects and also is not shifting the terms of a contract in order to profit.

2.6 Size

Globally, customers under amount of energy consumption are usually left out of the ESCO market. The reasons for this are that the transaction costs involved in projects with these customers too high and the energy savings are too low to justify performance contracting (Witte et. al. 2001). Additionally, in general certain borrowers such as low income earners and small business owners may experience difficulty obtaining affordable credit for energy efficiency as well as other investments (Golove et al. 1996).

Interviews
This condition of the general exclusion of smaller customers was observed in interviews with four Swedish ESCOs as shown in Table 2 below. The fourth ESCO listed below uses existing customers from their facilities management business as their ESCO customers. These facilities management customers are not smaller than the sizes in the table below.

Table 1: Minimum Customer Sizes for Four Swedish ESCOs

ESCO 1	100,00 square meters
ESCO 2	Minimum annual energy bill of 1.5 million SEK
ESCO 3	Project must generate >100,000 SEK in energy savings
ESCO 4	No size is too small

The potential ESCO customer perspective – Size

- A potential ESCO customer should be over a minimum size.

According to interviews with four Swedish ESCOs this minimum size must be at least 100,000 square meters or have a minimum yearly energy savings potential of 100,000 SEK. A size requirement for ESCOs is not given here, however, a certain size is necessary given all of the capacities that they must provide in terms of financing, staff, and other areas.

[23] Manuel Swärd. Personal Interview.

2.7 Evaluation Criteria – Summary and Analysis

The evaluation criteria that have been determined in Section 2 from literature and interviews with Swedish ESCOs are listed below. As already stated in the scope, this list is certainly not exhaustive.

The potential ESCO perspective

Staff (Capacities)

- Project Managers with the ability to manage subcontractors, and salespeople that are dedicated to only performance contracting
- Energy Engineers – they can also do other jobs other than performance contracting
- Employees with social skills
- Legal Competence
- Tools, and skills in finance, economics, and accounting
- An ESCO must have the necessary technical competence
- The customer must have a relatively lower non-financial capacity (e.g. staff and technical expertise) than the ESCO in implementing an energy efficiency project that is significant enough to demand the ESCO's services.

Energy Savings Potential

- Must have a market of a critical mass of potential projects with over a certain amount of energy savings potentials as a percentage of potential customers' total energy bills

Financing

- In the case of barriers for ESCO customers of providing project investment, an ESCO must have the ability to invest in its own projects. In the case that it is financing its own projects it would be beneficial if the ESCO is able to gain low interest rates.

Planned Effective Partnership

- Trust in the ESCO from potential customers is very important. Customers must be able to trust that an ESCO has the competence to conduct projects and also is not shifting the terms of a contract in order to profit.

The potential ESCO customer perspective

Staff Capacities

- The customer must have a relatively lower non-financial capacity (e.g. staff and technical expertise) than the ESCO in implementing an energy efficiency project that is significant enough to demand the ESCO's services.

Energy Savings Potential

- An ESCO customer must have at least a minimum energy savings potential as a percentage of their total energy bill

Financing

- The potential customer should have significant possible energy efficiency investments with payback times that an ESCO would be willing to take, but that are too long to meet the organization's internal investment criteria.
- The potential customer must have a good credit rating and a stable and good general profile.

Planned Effective Partnership

- The organization should be one that is interested in developing its own staff.

Size

- A potential ESCO customer should be over a minimum size.

The above evaluation criteria demonstrate that the ESCO business is a complex process that puts significant demands on actors entering the ESCO business. From a potential ESCO customer perspective, one factor that this analysis does not mention is the likelihood that an organization with an existing mindset toward environmental issues and\or energy efficiency may welcome an ESCO more easily and also better work with them during a project due to this pre-existing mindset. Additionally, disregarding energy cost savings, the possibility remains that an ESCO customer may simply not want or need the services that an ESCO is providing. For example, if an ESCO specializes in building automation, a potential customer may want to preserve a historic appearance and feel of a building and not want to modernize its facility in this way.

Another factor that is not taken into account in this analysis is the ability of a customer to make a decision regarding a performance contract due to the internal power structure or other factors. According to the World Bank (1999):

If the ESCO deems the decision-making process at the customer level excessively problematic, it may decline the project.

Finally, the ESCO business and energy service contracts are a dynamic process. Although not regarded here as an evaluation criterion, the ability of an ESCO to differentiate its services and/or lower its costs will serve to make it more competitive, as with any business. For example, YIT employee Anders Nygren estimated that 50% of their project costs were for labor and 50% were equipment.[24] Since this ESCO's customers are existing customers for their core business of facilities management then this is assumed to reduce the costs involved for prospecting/proposal generation as they already have this customer. Since they already possess knowledge of the building and operations then it is also likely that this organization also experiences less costs involved with measurement and verification, project design.

The reverse of this situation occurs with Siemens. When a performance contract is over, Siemens may try to retain customers by selling them additional services in building automation. Since the profit margin is higher on performance contracting than building automation, then Siemens always tries to sell the customer performance contracting as a top priority in the beginning.[25]

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[24] Anders Nygren. Telephone Interview.
[25] Frank Johansson. Personal Interview.

These two examples show how an ESCO with a pre-existing core business may be able to develop its ESCO concept in a synergistic fashion with its existing business. One advantage that an ESCO might gain from possessing a core business other than performance contracting is that some of their costs involved in a project may be lower. On the other hand, the more a company makes a given business its core competence, in this case performance contracting, the more it might be possible to outcompete other businesses with less specialization in that area.

3 Energy Efficiency in Organizations and ESCOs – A Theoretical Framework

This section will provide a theoretical background for the achievement of greater energy efficiency within organizations, which is used to provide a general context for the assessment of three Lund real estate actors as potential ESCO customers discussed in Section 4. Factors within organizations for achieving greater energy efficiency given in literature are reviewed along with the potential for ESCOs improve conditions associated with these factors. Reductions in energy use among organizations can reduce their operating costs. Given the variety of benefits of energy efficiency and the cost-effective energy savings potentials agreed on by many authors, the questions remains: Why is it that more organizations do not implement greater energy savings measures?

There are a variety of ways to analyze why there is a gap between the possible cost-effective energy savings investments within organizations and the actual energy savings measures implemented in organizations. The economic approach views organizations and their employees at maximizers of utility (Sorrel et al. 2001). The sociological approach sees many relevant actors involved with each consumer's energy use, such as banks, architects, subcontractors, real estate organizations, tenants, regulatory agencies, each with different interests and priorities, (Lazarova 2002). The distinctions between these different perspectives are often, according to Sorrel et al. (2001), "blurred and contentious". It may be easier to group factors within organizations for achieving greater energy efficiency into three conditions. Of course, if an external organization such as an ESCO is able to provide these conditions, then that organization may be successful in implementing greater energy efficiency.

This approach allows for a focus on barriers and opportunities without the lines formed by these separate disciplines, which is also the reason why the word "factor" is often used when relevant in this research instead of "barrier." A factor, such as energy prices, never goes away but is able to be adapted and changed, however barriers are conditions that can be alleviated. The word barrier is still often used in order to make a distinction (e.g. from an opportunity) or to not deviate from the intent of an author that is being cited.

First, a pre-condition for greater implementation of energy efficiency with organizations is that an energy savings potential actually exists.

1. Organizations and their employees must see and understand the benefits of greater energy efficiency.

Availability, Access, and Quality of information
Three types of information regarding energy use are the energy consumption of specific equipment, the energy consumption of buildings or parts of buildings, and information on possible energy efficiency improvement investment opportunities (Sorrel et al. 2001). Even if the general financial benefits of reducing energy are understood, an organization may lack a way to evaluate which investments to take. One way of gaining a greater knowledge of energy consumption to better understand what steps can be taken in energy management is through metering of energy use (Lazorova 2002), and increasing this metering in its frequency, locations, and accuracy.

<u>ESCOs</u>

An ESCO can help serve to provide an organization with an improved knowledge of their energy consumption through the service and possibly capital investment (e.g. metering) it provides in monitoring and verification, and the associated training of a customer's staff that may come with this.

Accounting
Organizations often have greater information on the cost of capital than the operating costs of this capital, including energy use (Sorrel et. al 2001). Viewing these operational costs as controllable rather than fixed costs, and thus an opportunity to lower costs, may help alleviate this barrier.

2. Employees and/or organizations must be able to implement energy efficiency measures

Time & Priority
Management may not provide sufficient support for energy efficient improvements if these improvements may further burden employees under time and workload pressure, including the managers themselves, with further work (Seabright & Smith 1996). Simply stated, the core business of most organizations is not in energy efficiency (Wuppertal Institute 2003).

ESCOs
Although it does take resources for an organization to become an ESCO customer (e.g. legal resources and time spent in training), ESCOs can provide staff, management, and technical capacity for organizations in achieving greater energy efficiency.

Financing
Most organizations prefer to invest in their core area of activity over investments in energy efficiency, even if the estimated return on investment is higher with investments in energy efficiency (Wuppertal Institute 2003). The structure of an organization's budget and accounting practices may play an important role in their ability or lack of ability to finance energy efficiency improvements. Energy costs may be put into overhead costs, rather than costs that are allocated into a specific department or process. By assigning responsibility to overhead costs, such as energy costs, this can motivate managers to make lower cost energy management decisions (US EPA 1995).

ESCOs
An ESCO can arrange for or provide for project financing, along with giving guaranteed savings on this financing.

Power
Managers and employees within an organization may lack the power to initiate changes (Sorrrel et al. 2001). For instance, if energy decisions are made by a different branch of the organization, then employees may have no say over investments in energy efficiency or other possible changes. In public organizations, a lack of political will may inhibit the achievement of greater energy efficiency because investments in greater energy efficiency can be "invisible" to politicians in that they do not contribute to their public image (World Energy Assessment 2000).

Transaction Costs
For buyers and sellers in implementing energy efficiency projects transaction costs may inhibit these buyers and sellers from realizing projects (Sorrel et. al 2000). Transaction costs represent a grey area where high transaction costs may be seen market barriers, since these transaction

costs represent the interface between buyers and sellers. These costs, however, can also be seen as organizational barriers since different organizational structures may lower transaction costs by changing elements of their structure. This may be difficult to accomplish, especially in the case of smaller customers (Sections 2.7.1 & 6.3.2).

One interpretation of why energy efficiency investments are not undertaken corresponding to their cost-effective potential is the risk and uncertainty involved. One source of uncertainty stems from transaction costs due to a lack of knowledge of what the costs will be for searching for information, and other "hidden costs" that may not be obvious or quantifiable to investors such as training, installing, and maintenance (Golove et al. 1996).

ESCOs

The ability of an ESCO to reduce transaction costs in an energy efficiency project is unclear. According to Ostertag (1999), additional costs may accrue when ESCOs make contracts with their subcontractors, which could be more costly than if the customer dealt individually with each of these subcontractors. On the other hand, the specialization and experience that an ESCO has in negotiating these contracts with its customers and subcontractors may lead these costs to decrease. Ostertag (1999) concludes this argument by stating that transactions costs are not static, and may be decreased due to "economies of scale and learning effects."

Continual Improvement

Initiatives within organizations in environmental management in general may achieve initial success but often fail to show continuous progress after the projects stop (Stone unpublished). It is reasonable to assume that this occurs in the area of energy efficiency in general also, given Stone's explanation for why this occurs. Individuals and organizations hold "theories-in use" and espoused values. Theories-in-use are underlying assumptions and values. Espoused values, on the other hand, reflect stated assumptions and values (Senge 1990, p. 202), such as an organization's official mission and goals (provide the best service, gain market share, gain profits, etc.) or rules it holds, but may or may not reflect underlying thinking. To illustrate how this works in the context of energy efficiency it is useful to take the example of a janitor that learns a new more energy efficient maintenance routine for a boiler as part of an energy efficiency education program within an organization. The janitor, and other employees, may incorporate this knew knowledge in the measures in which they are educated. However, when new problems arise, the janitor's way of thinking about energy will not fundamentally change unless he or she fundamentally changes his or her assumptions and values. If this new knowledge exists only on the surface, then his or her core old values and assumptions will be used to attempt to fix new problems. Thus, continual improvement is greatly strengthened if the lessens that are learned are internalized. Of course, the ability to achieve continual improvement is dependent on the technical and cost-effective limitations of improvement. In addition, the ability to achieve continual improvement may be relatively greater within the larger scope of environmental management, than in one of the elements of environmental management, energy efficiency.

ESCOs

According to Goldman et al. (2002), one of the claims made by ESCOs is that the mere existence of long-term contracts with customers and the resulting relationships that occur between customers and ESCOs cause further energy savings to be identified. There are two reasons why this might occur. First, in many instances customers find additional energy improvements over time as their attitude toward these improvements gains increasing favor (Goldman 2002). Secondly, performance contracts may that last over a few years may

encourage longer term thinking because they demand that energy issues be thought of in a longer time frame than previously.

ESCOs often provide training to their customers, possibly including increased or improved operation and maintenance routines. Changes to these implicit rules or norms of operation and maintenance and other areas of energy management, may have the potential to change long term internal mentality of employees. On the other hand, an ESCO's measures may sometimes only represent "low hanging fruit," the investments that require the least structural changes within an organization and the lowest payback times, and thus may not contribute to lasting improvements since the path toward greater and more difficult future improvements may be unclear for an organization based on their experiences in obtaining these low hanging fruit.

3. Organizations and/or their employees must be given accountability and/or rewards for their decisions influencing their energy consumption.

Accountability & Incentives
Managers and employees that are directly responsible for energy costs are more likely to become more accountable over their own influence over the organization's energy consumption (Sorrel et al. 2001). On the other hand, if these managers and employees are rewarded for reduced energy costs, then this may also reduce energy use. For example, purchasers of equipment may be responsible for the costs of capital, but not for its operating costs (Sorrel et al. 2001). If these purchasers were responsible for the total life time costs of this equipment, then this might change their purchasing patterns. Similar "perverse incentives" exist with many traditional suppliers and designers of buildings and the equipment in them. Since these actors usually make more money if they sell more equipment, then they have an incentive to sell the customer more, not minimize the customer's costs (Lovins 1997).

<u>ESCOs</u>
Since ESCOs share the financial results of energy savings with their customers, then this can be regarded as an incentive for the organization to reduce energy during the length of the ESCO project. It is unclear, however, how much influence ESCOs may have on the behavior of their customers with regard measures involving many dispersed users that each use relatively low amounts of energy, such as turning off equipment (e.g. lights) during hours when they are not in use.

Billing Structures
Billing Structures play an important role in giving organization accountability and/or rewards for its energy use patterns. Two examples of this are split incentives, and fixed and variable electricity prices.

Billing Structures - Split Incentives
Split incentives is when two parties take part in a transaction and neither party has an incentive to reduce energy use (Sorrel et al. 2001), such as "one party selecting the technology, another paying its energy costs" (Lovins 1997). If the tenant is responsible for paying the energy bills to a third party that is not connected to the investor, manager, and/or owner of the building, then this investor/manager/owner has little direct financial incentive to reduce energy use in the building. The renter will most likely not want to invest in greater energy efficiency because they simply may not want to think about this issue, and the payback time of their investment may be longer than their anticipated stay as a tenant in the building (Sorrel et al. 2001).

Billing Structures - Fixed and variable electricity prices

Electricity is almost always sold to consumers through average prices. The real cost of supplying electricity is not steady, as with the price that is sold to consumers, but fluctuates, sometimes widely, since electricity cannot be stored. The cost of supplying electricity involves the fixed costs involved in supplying electricity to each customer and the variable costs that come from the changes in the hourly electricity market. Electricity prices fluctuate according to demand throughout each day and different season.

One factor for achieving greater energy efficiency within organizations is how electricity is bought and solid, either on fixed or variable rates. Electricity is often sold to organizations by energy suppliers and/or internally within organizations at fixed rates. The lack of correlation between the retail cost of electricity and the prices paid by consumers leads to inefficiency in a number of ways. Real time (or more variable pricing such as hourly or daily) pricing refers to charging customers for electricity corresponding to the variable costs that it takes to sell it, rather than at fixed average prices. By sending more accurate signals to users, they are able to adjust their demand during peak demand in order to save money (Summit Blue Consulting 2004). This factor may be an internal condition within organizations when it reflects their purchasing and internal selling decisions, however, since it is also a factor motivated by the energy supplier and energy market as a whole, it will be discussed in relation to ESCO markets in section 6.3.1.

Causal Linkages

In order to understand how these barriers may relate to one another it useful to make a causal relationship diagram (Figure 3-1). An organization may implement many energy efficiency practices. Increased knowledge of energy consumption may lead to a understanding by an organization of some of the benefits of reducing consumption, which may lead to an increased amount of data collection, new capital investment, and/or a variety of other measures. For an organization to achieve longer term on-going improvement changes in their tacit "theories-in-use" and explicit goals will allow for this process to continually develop. Alleviating barriers within "practices" and "knowledge and information", however, may cause individuals and organizations to internalize lessons learned, although this process could, of course, work in a variety of ways. When tacit and external goals and norms and/or practices are changed, this may alleviate inertia associated with certain barriers. Inertia is listed by some authors as a barrier (Sorrel et. al 2001), however, it is not considered by this research as a barrier (or cause) but rather an effect, possibly created by the current "theories-in-use" within an organization.

The counterbalancing forces that may prevent such a reinforcing loop of energy efficiency improvements may include the barriers listed above, along the technical abilities of staff, the overall broader mindset and culture of that the organization exists within, and the overall cost-effective energy savings potentials available. A limitation of this figure is that tacit and explicit norms may not be as important as access to capital in some cases with energy efficiency measures related to *capital investment*, although a great deal might still be accomplished through changes in behavior.

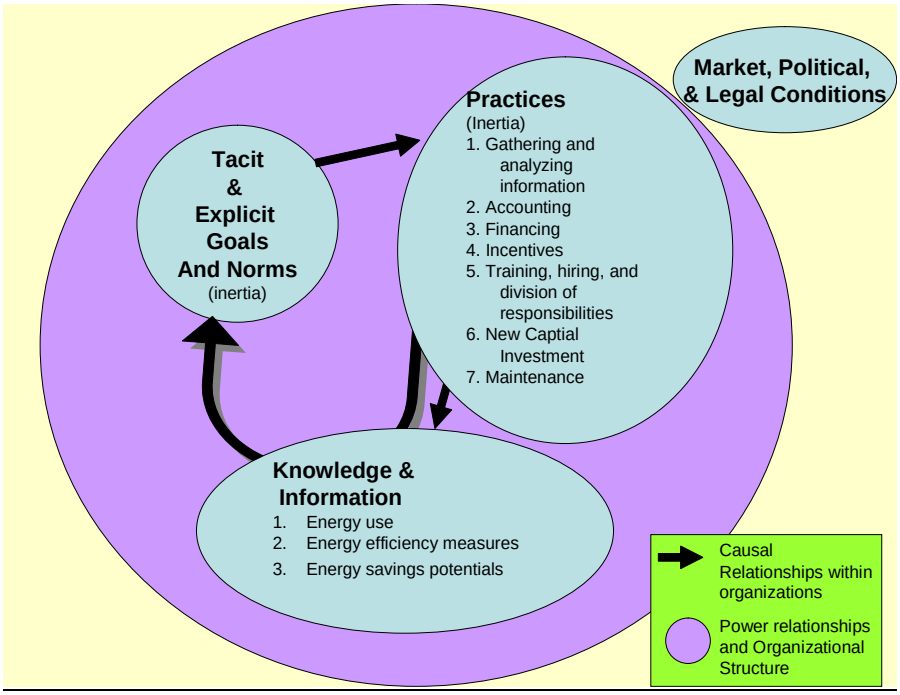

Figure 3-1: Causal Relationships between factors inhibiting and/or generating greater energy efficiency within organizations

Internal ESCOs

Finally, some aspects of performance contracting may be used within organizations instead of these organizations relying on the outsourcing services of an ESCO. An organization can create something similar to an "internal ESCO" or "intacting" (Kristof & Ramesohl 2004). In this case one actor under the same administration as another actor can serve as a provider of energy efficiency services for another actor within a different organizational unit. The commonality with a performance contract is that 1) one actor provides or arranges for project investment of energy efficiency improvements for a second actor, and that 2) just like in performance contracting, the internal ESCO's revenues are directly tied to the energy savings. Once an initial funding is given, this concept can financially stand on its own through project revenues. Just as with ESCOs, intacting exists in various forms, such as a newly created organization owned by the principal organization, a separate profit centre within the main budget of a company, or through an existing department, such as the environmental management department. An example of this concept is the German city of Stuttgart, where the environmental department functions as a "contractor" for other departments within the municipality, as shown by the figure below (Kristof & Ramesohl 2004).

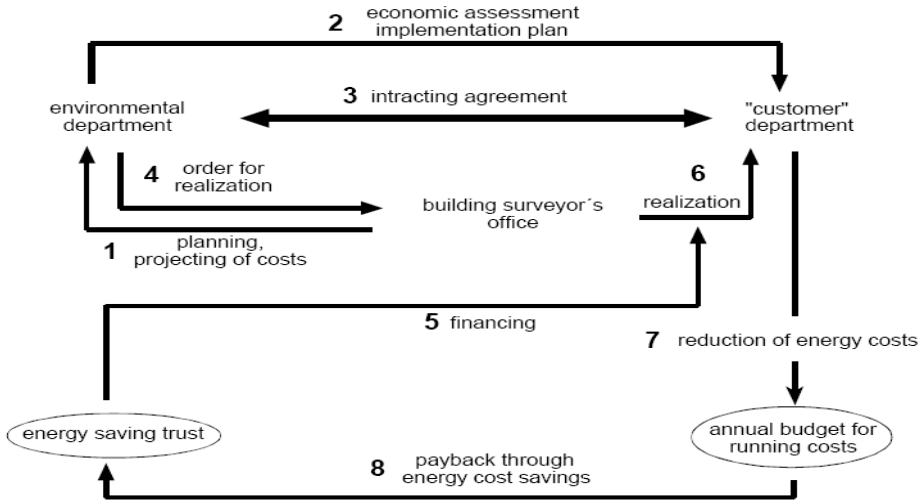

Figure 3-2: Stuttgart Internal ESCO Model
Source: Kristof & Ramesohl (2004)

Ramesohl and Kristof (2004) provide a few comparisons of ESCOs and intacting. First, the shift in the responsibility of arranging or providing for financing and performance risk to an ESCO is one reason why organizations may demand an ESCO's services. However, intacting can be beneficial when organizations may also not want to shift control to an outside actor. Secondly, intacting may be more effective for an organization in achieving long term organizational learning, in conducting smaller scale projects, and when internal knowledge is more useful in solving problems than external expertise. ESCOs, on the other hand, can provide manpower to an area outside of an organization's core competence and technical expertise that comes with specialization. Ramesohl and Kristorf (2004) point out that the concepts of internal ESCOs and ESCOs can be complementary, as the existence of an internal ESCO can lead the way to a greater acceptance of an ESCO project and an understanding of how an organization's technical competence or other limitations may justify the use of an ESCO's solutions.

Summary

ESCOs can improve an organization's availability, access, and quality of information concerning its energy use. They also give organization greater power to implement energy efficiency measures due to their assistance in areas such as staff, training, and financing. ESCOs give a natural incentive for organizations to reduce their energy use because the organization will be provided with part of the shared financial savings that result from ESCO projects. However, although the actual participation of an ESCO with regard to behavioural related energy efficiency improvements are a case specific and uncertain. No direct relationship was found from this analysis between the factors of power, accounting practices, and split incentives for organizations in achieving greater energy efficiency, and ESCOs. This does not mean, however, that these relationships do not or cannot exist. It is uncertain what affect ESCOs may have on the transaction costs for organization in gaining greater energy efficiency and on the continual improvement of energy efficiency within organizations, although there is reason to believe that on a case specific basis some considerable progress may be made in these areas by ESCOs and their customers. Finally, some of the benefits of the ESCO model may be able to be used internally in an organization, and may be preferable given a potentially greater ability of an "internal ESCO" to achieve continual improvement, and given certain demands and organizational structures.

4. Three Lund Real Estate Actors

Lund municipality is one of three municipalities within the Swedish Region of Skåne. Lund University has a significant influence on the character and population of Lund. As of June 2004 the population of Lund was approximately 100,491, with a student population of 38,000 listed by the Lund University website.[26][27] In 2002 there were 47,140 apartments in Lund and 17,417 small houses.[28]

This section will evaluate three Lund real estate actors for their potential as ESCO customers. This will be done to:

1. Investigate what the experience has been with three local organizations with achieving greater energy efficiency and what performance contracting might help to improve this situation. These case studies can be used to provide more general observations on barriers and opportunities for greater growth in the number of ESCO projects in Lund and Sweden.

2. Evaluate these three customers as potential ESCO customers, and as customers of a potential local ESCO, Lunds Energi. This would serve to qualitatively develop the ESCO market by both adding a local actor as an ESCO and expanding the scope of the ESCO business concept to include energy suppliers.

These three actors provide a diverse perspective. One organization has a great deal of internal capacity in achieving greater energy efficiency (Akademiska Hus). One organization represents a good candidate to become an ESCO customer (Lundafastigheter). Finally, one organization is a possible ESCO customer that has entered the beginning stages of a performance contract (Region Skåne). Additionally, these three case studies provide practical examples of factors inhibiting and fostering greater energy efficiency within organizations, such as billing structures, accountability and incentives, and the availability, access, and quality of information.

Market factors, or factors involving the interaction between buyers and sellers, may be considered outside of the primary scope of this section. However, these barriers will be considered when they directly affect the three Lund real estate actors in this section.

Background on Lund Energy Market

Lund Agenda 21 has set a goal to reduce all energy use, excluding transportation, by 25%.[29] In the Swedish deregulation electricity market, consumers buy electricity from different retailers. Heating services in Lund are dominated by Lunds Energi, which serves as an energy producer and retailer (further description in Section 5) and owns the local district heating grid. 96% of the Lund municipality heat customers are connected to this grid, with the remaining 4% connected to natural gas (with can also be provided by Lunds Energi), bio-fuel, geothermal, and other sources. The three real estate actors in this research all receive Lunds Energi's services for district heating, in addition to receiving heat supply from other sources. District

[26] Around 15,000 of these residents are registered as students. There are some students who live within Lund but are not registered as residents. An analysis of these numbers is beyond the scope of this research; however, in any case it is clear that Lund is a town where the students make up a large segment of the population.

[27] Lunds Municipality. (2004). [Online]. Available: http://www.lu.se/info/facts/facts_eng_2003.pdf

[28] Lunds Municipality. (2004). [Online]. Available: http://www.lund.se/templates/Page.aspx?id=395

[29] Lunds Energi. (2004). [Online]. Available: http://www.lund.se/templates/Page.aspx?id=3631

heating is a method of using heat generated from one or several production plants and distributing this heat through a system of pipes using hot water or steam as a carrier of heat. Buildings can then use this heat for space heating and hot water heating (Sjödin 2003, p. 6). Lunds Energi owns the district heating pipes that connect the production units to the customers, with 4,000 connection points to this network. 2,400 of these connection points are for single family homes with the remaining being apartment complexes, industries, public buildings or other buildings (IIIEE 2004).

For 2003 Lunds Energi supplied 875 GWh of district heating, 47 GWh of district cooling, and 198 GWh of natural gas. Lunds Energi's electricity grid supplied 1600 GWh.[30]

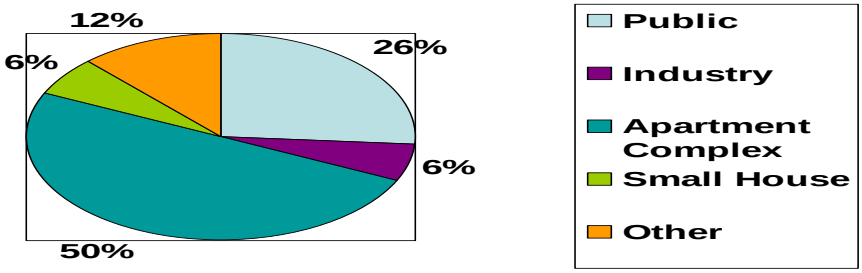

Figure 4-1: Share of total district heating consumption for Lunds Energi customers[31]
Source: Lunds Energi Årsredovisning 2003

The focus of this section is on public actors, which as already stated typically make good ESCO customers. Public actors can be shown to represent 23% of Lunds Energi's district heating supply or 227.5 GWh.

Common Factors

1. Electricity Sold at Fixed Rates

One factor in an organization's capacity to achieve greater energy efficiency that was fairly similar in all three organizations (and therefore is not need to be described on a case specific basis) is the selling electricity at fixed rather than variable rates. This factor can be illustrated by the example of Akademiska Hus. Stig Hoff is in charge of buying electricity for all of Akademiska Hus' branches in Sweden. He buys electricity on an hourly basis at a variable cost and then sells it to different branches of Akademiska Hus at flat rates.[32] Customers send their bills to Mr. Hoff's office based on a fixed rate for electricity per kWh. The different branches of Akademiska Hus are then either required to pay money or are sent a check according to whether or not the flat rate they were charges was above or below the actual average price of electricity.[33]

Considering the size of these organizations it is reasonable to assume that there may be a potential to save a significant amount of money by charging variable electricity rates to certain areas where running times for equipment can be changed to run at off-peak times, such as hot water heating.[34] The same service might be provided with less energy given a variable billing

[30] Lunds Energi (2003). Årsedovisning (Annual Report).
[31] Lunds Energi's delivery of district heating for 2003 was (GWh): Apartment 437.5, Other 105, Public 227.5, Industry 52.5, Small Houses 52.5, Total 875
[32] Stig Hoff. Telephone Interview.
[33] Phillip Altenhammar. Personal Interview.
[34] Tomas Kåberger (IIIEE). Personal Correspondence.

structure, however, there are other concerns that must be taken into account. Representatives from these three real estate organizations generally observed that their organizations and their tenants favoured flat rates due to the perceived convenience. Additionally, the administrative burden of a flat rate procedure may be easier to implement.

The three evaluation criteria listed below are not evaluated into detail in the next section since they all exhibited similarities among the three real estate actors:

- Size

The sizes of the three organizations are well over the minimum sizes stated for potential ESCO customers by four Swedish ESCOs interviewed who require that customers should have at least 100,000 square meters or have a minimum yearly energy savings potential of 100,000 SEK (approx. 12,500 euros).[35] The sizes of Akademiska Hus i Lund (in Lund only), Lundafastigheter, and Region Skåne are 345,000 m^2 (floor space), 503,000 m^2[36], and 405,000 m^2 respectively.

The potential customer must have a good credit rating and have a stable and good general profile
Since all three actors are public actors, they are believed to have good credit ratings and are not likely to soon become insolvent.

- Planned Effective Partnership - Trust in the ESCO from potential customers is very important.

The issue of trust is an intangible factor that is hard to quantify. Although there is currently no reason to believe these three organizations could not place trust in an outside actor, no findings were made in this area.

4.1 Akademiska Hus

The scope of this section will primarily focus on the activities of Akademiska Hus in Lund that are conducted with Lund University in Lund. "Akademiska Hus" will refer to the activities of Akademiska Hus in Lund located within Lund, unless specified otherwise. This section will review Akademiska Hus' experience, potentials, and plans in implementing energy efficiency in Lund in order to evaluate Akademiska Hus as a potential customer of an ESCO.

Akademiska Hus is a state owned building owner that rents out buildings to universities across Sweden. Akademiska Hus was created 10 years ago when Byggnadsstyrelsen, a state owned company with a much broader scope, split into separate entities.[37] This organization is now divided into a number of other organizations. The company is required to deliver a 7% profit to the state. All subsidiaries of Akademiska Hus will receive ISO 14001 certification once, in March 2005.[38] One of Akademiska Hus's divisions, "Akademiska Hus' in Lund" owns and manages property on University grounds in Southern Sweden in Lund, Alnarp, Malmö, Kristianstad, and Kalmar. Lund University is the organization's biggest tenant with 345,500 square meters of floor space (Akademiska Hus i Lund 2003). This accounts for approximately 60% of the buildings in all of Lund University.[39]

[37] Phillip Altenhammar. Personal Interview.
[38] Kerstin Gustafsson. Personal Interview.
[39] Roland Larsson. Personal Interview.

4.1.1 Akademiska Hus – Experience with Energy Efficiency

Energy Savings Potential *- An ESCO customer must have at least a minimum energy savings potential as a percentage of their total energy bill*

The M-House Audit

An electricity consumption audit was conducted of the "M" house at the Lund Institute for Technology in June 2003 by six students of the Department of Heat and Power Engineering.[40] According to Roland Larrson, the activities and building characteristics of different buildings at Lund University often vary greatly. However, *figure 4-3* below, which is taken from the energy profile created from the M-House audit, can be seen as a fairly representative picture of energy use of Akademiska Hus's buildings in Lund.[41]

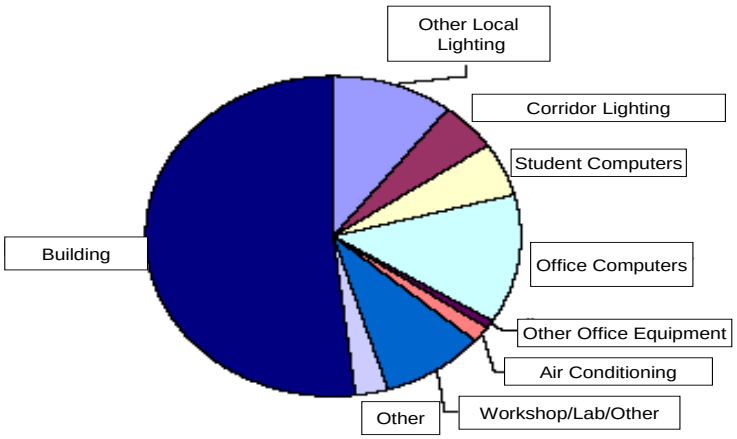

Figure 4-0-2: Different Uses of Electricity for the M-House

According to the M-House audit study, there is an energy savings potential for 27% of the current electricity consumption through behavioural changes in this building. Most of these potential savings come from the potential to reduce running hours of equipment such as lighting. Roland Larsson, head of technical administration at Akademiska Hus, estimates that approximately 60% of the peak electricity power load is used by Lund University during the night. In many instances this equipment is running to perform necessary tasks such as conducting experiments. Mr. Larsson estimated that the potential to reduce consumption of this night time power load due to behavioural changes are about the same as the results of the M-house audit[42], meaning that there is potential for a 27% reduction of the night time electricity consumption. This would reduce the night time power load to 44% of the peak load.

Conclusion

It is also unknown whether an ESCO could capitalize on energy savings potentials observed in the M-House audit, although this may be unnecessary since Akademiska Hus is already taking

[40] Consumption data and time of use were put into a database. Students estimated energy savings potentials by using power meters, interviews with users of equipment, night checks to see what equipment was left on, sensors and data loggers. Additionally, electricians surveyed permanently installed measures of greater size using pliers to read amps (Student from the Department of Heat and Power Engineering. Personal Interview).

[41] Roland Larsson. Personal Interview.

[42] Roland Larsson. Personal Interview.

significant steps in providing incentives for its employees and tenants to reduce energy consumption in their buildings through their billing structure and increased metering. Additionally, Lund University is also initiating education and marketing programs to promote energy conservation behavior.[43] According to Roland Larsson, Akademiska Hus has already picked many of the "low hanging fruit" energy efficiency investments involving adjustments to existing equipment and systems (Table 3), however, it is unknown what energy savings potentials may exist with the installation of new systems.

Capacities - *The customer must have a relatively lower non-financial capacity (e.g. staff and technical expertise) than the ESCO in implementing an energy efficiency project that is significant enough to demand the ESCO's services.*

Akademiska Hus i Lund has 75 employees in property management, with 36 of these in the department of engineering. Six employees head this division. The remaining 30 employees are divided into six zones. Lund University makes up four of these zones. Lund zones each have one property manager and five technicians. Each of these technicians is responsible for a specified area.

Billing Structure & Incentives

Akademiska Hus currently charges rent to their tenants in one bill, with energy use included in this bill and not listed as a separate item. This is starting to change. Negotiation has begun for new 10-12 year contracts for all academic buildings related to "technical" disciplines. Most of the existing contracts for these buildings will expire soon. There has been a group for 3-4 years that has discussed energy efficiency issues at Lund University made up of Akademiska Hus and Lund University representatives. The work of this group led to a verbal agreement between Lund University and Akademiska Hus that energy use will be separated from rent in the future. One way of doing this will be for a split to be made between "property energy consumption" or the base energy use, and energy use that can be attributed to tenants.[44] For example, this change has already occurred in the M-House, where there is currently a 50/50 Akademiska Hus/Lund University split, corresponding to the results in *figure 4-3*.[45]

The government rules set for Akademiska Hus regarding energy billing structures are relevant when mentioning the internal motivation for this organization to reduce energy in its buildings. First, under the current energy bill structure heat and electricity are included yet indivisible from the overall rent payment. Under this new billing structure, Akademiska Hus can take some of the energy savings that result from its investments in energy efficiency. Under this new billing structure, electricity will be shown as a separate charge that will vary according to the use attributed to the user, with the organization planning to keep heat included and indivisible from the overall rent. Once the electricity bill is separated in this way from the overall rent bill, then Akademiska Hus will lose the ability to recover investments in energy efficiency related to electricity that concern *the electricity use attributed to the user*. An advantage of this set-up, as shown by the audit of the M-house, is that electricity use attributed to the user can often be reduced due to behavioural measures. Lund University actors will

[43] These activities include: 1)15,000 pamphlets and some posters were distributed as part of an information campaign 2) Further plans include a marketing campaign focused on the "trendsetters" within the IT sector, and 3) Increasing marketing and information on energy efficiency to students (Kerstin Gustafsson. Personal Interview.)

[44] In the case that the base energy use is separated from tenant use using two separate meters there may be a reason to use more meters to further divide electricity bills (Kerstin Gustafsson. Personal Interview). .

[45] Kerstin Gustafsson. Personal Interview.

have a greater incentive to do reduce their electricity consumption and will be able to see their energy use more clearly in their bills.

Akademiska Hus has had their current system of metering media for ten years. Most houses have one heat meter and one electricity meter. In about 10% of houses there are two electricity meters used to separate base electricity consumption from the electricity consumption attributed to tenants.[46] Akademiska Hus is investing in a new metering system that will give hourly electricity, heat, and water measurements in every house. Additionally, in 2005 they plan to create their own meteorological station. They currently buy their meteorological data.[47]

Incentives for increased Energy Efficiency

A key issue for an organization to reduce energy use is whether or not the organization as a whole and/or the divisions and employees within it receive benefits if they reduce their energy use due to behavior or capital investments in their buildings. In 2000 Akademiska Hus began giving its staff internal incentives for increasing energy efficiency in their buildings. Additionally, they have recently educated their technicians in auditing and energy efficiency.[48]

Kerstin Gustafsson, environmental manager for Lund University, stated that giving some of the money generated from energy efficient investments are distributed to the Lund University staff or department that occupies the area where this investment was made helps secure the acceptance and success of these investments.[49]

Energy Efficiency – Adjustments to Existing Systems and Equipment

The long term goal of the entire Akademiska Hus organization within Sweden is to reduce energy use in its buildings by 30% in the next 25 years.[50] In Lund, Akademiska Hus has been lowering their electricity and heat use per square meter per year considerably since 1996 as can be seen in *Table 3* below. In this table, the energy use columns with "rented area" means that this is the area that customers pay rent for. Other areas, named here as "non-rented area", are areas that customers do not pay rent for, such as basements in some cases. From 1993 to 2003 Akademiska Hus reduced the electricity and heat usages per square meter in its buildings by 10.9% and 27% respectively (customer + other).

[46] Roland Larsson. Personal Interview.
[47] Roland Larsson. Personal Interview.
[48] Kerstin Gustafsson. Personal Interview.
[49] Kerstin Gustafsson. Personal Interview.

[50] Stig Hoff. Telephone Interview.

Table 2: Heat and Electricity use per m² for Akademiska Hus's Lund University Tenants, 1996-2003
Source: Akademiska Hus

Year	Heat m² (rented area)	Heat m² (rented area + non-rented area)	Electricity (rented area)	Electricity (rented area + non-rented area)
1996	168	135	139	112
1997	168	135	147	118
1998	185	149	164	131
1999	184	148	162	131
2000	166	134	153	123
2001	159	129	162	131
2002	149	120	138	111
2003	134	106	127	101

Akademiska Hus Head of technical administration Roland Larsson estimates that 90% of the energy savings during the last 5 years have resulted from these four measures below:

- Building Automation – 80% of their buildings now have building automation
- Working hours of equipment have been reduced by adjusting speeds, adding sensors, etc.
- Balancing of temperature in heating systems
- Electricity savings from light control sensors

In order to achieve the above measures about 100,000 SEK has been invested in the last 5 years, a very small amount compared with the energy savings that have been achieved. This investment has been put in to:

- Education
- energy diagnosis
- optimization of HVAC systems
- Measuring of energy use

According to Stig Hoff, payback times for investments taken by the Akademiska Hus organization for all of Sweden generally fall between three to five years, although they can run as long as eight to ten years. The planning of projects is done by Akademiska Hus but everything else is outsourced.[51]

Energy Efficiency – New Systems and Equipment

[51] Stig Hoff. Telephone Interview.

Akademiska Hus is planning and implementing new energy supply and delivery systems. Although the scope of this thesis pertains to energy efficiency and not energy supply, the supply side of their strategy is worth mentioning in the overall context of their plans. A normal delivery of such contracts is 8-15 years.[52] These new systems are not implemented in the majority of buildings and therefore can be regarded as case specific. A few examples are given in this section.

1. A system that pumps water into the ground and uses an alcohol and water solution as a heat exchanger with heat in the ground and ground water. The advantage of using this technology over a geothermal system is that this alcohol and water solution heats up faster than water. This type of system has already been implemented in Lund at the house of astronomy and the new center for languages and literature, with construction planned for the chemistry department. Some government support was given for astronomy project but the other projects are not using outside financial assistance.

2. Akademiska Hus sometimes changes constant air volume (CAV) heating ventilation and air conditioning units (HVAC) systems to variable air volume (VAV) HVAC systems. The CAV HVAC systems typically receive around 50-60% efficiency while the new VAV HVAC systems garner around 70% efficiency. The inefficiency in the old system comes from the fact that it is one system instead of separate heating and cooling systems. The new system uses variable air flows causing energy to be used on an as needed basis. The new system also can run at higher speeds allowing more air circulation. These and other factors result in a more efficient system that uses less energy and provides a better indoor climate.[53] The new system costs around 20% more than the system it is replacing but this cost has a payback time of around 5 years.

3. Akademiska Hus is also investing in measures to increase its efficiency in the final delivery of energy. Measures in this area are energy efficient upgrades and normal upgrades of equipment when they wear out, which usually result in more energy efficient equipment.[54]

Conclusion

The Kristianstad branch of Akademiska Hus i Lund is currently undergoing performance contracting with Siemens.[55] According to head of technical administration Roland Larsson, the trigger that prompted the Kristianstad branch to hire an ESCO was a ventilation system that did not fit with government regulations and needed to be replaced. Mr. Larsson gives three reasons why Akademiska Hus i Lund chose to take Siemens. First, Siemens was cheaper than giving the work to contractors. Secondly, Siemens provides technical expertise to the project. Finally, it would have been difficult for Akademiska Hus i Lund to manage such a project given the workload of their existing staff and they did not want to hire a new employee(s). The most important factor out of these three, according to Roland Larrson, is technical expertise. Akademiska Hus i Lund already has a number of staff working on energy management, technicians and four property managers based in Lund. Additionally, the potential for a similar condition that triggered the search for a contractor to do work on the ventilation systems in Kristianstad is unknown according to this study. According to Mr. Larsson and Akademiska Hus operation and maintenance engineer Philip Altenhammar, it is in the area of

[52] Kerstin Gustafsson. Personal Interview.

[53] Phillip Altenhymen. Personal Interview.

[54] Phillip Altenhammar. Personal Interview.

[55] In the project in Kristianstad Siemens has guaranteed savings of 23%. In this contract the customer receives 80% of the savings after the 23% guaranteed savings is met and until saving passes 33%. At this point energy savings are then split 50/50 (Roland Larsson. Personal Interview).

implementing new systems and equipment to buildings, not the adjustment of older systems, where an ESCO's services might be wanted.[56]

Additionally, Akademiska Hus i Lund possesses all of the requirements for a potential ESCO given by the evaluation criteria in this thesis, except possibly that an "ESCO must have the necessary technical competence." Some examples of these capacities that they clearly possess are tools (e.g. software to read hourly energy consumption), project managers, and energy engineers. Given the above analysis, provided by Akademiska Hus i Lund's head of technical administration and one of their engineers, it is unclear how these statements match up with the fact that this organization presently implements sophisticated new systems in energy delivery and supply. Three possible reasons for this discrepancy are listed here. First, now that they are more familiar with the performance contracting process Akademiska Hus may decide receive performance contracting the next time they make significant new capital investments in achieving greater energy efficiency. Secondly, it is possible that projects are not of a critical mass in order to make them interesting for an ESCO. Finally, a specialized subcontractor may provide a greater expertise in a given area. The ESCO's need to absorb part of the savings of a project may lead to higher costs over a design-build contractor.

Despite these possible constraints, according to the responses given in interviews, Akademiska Hus may be a good potential ESCO customer for the replacement of its existing systems, especially in the case, as demonstrated by their branch in Kristianstad, that these existing systems experience serious problems or need to be replaced with age.

Financing - *The potential customer should have significant possible energy efficiency investments with payback times that an ESCO would be willing to take, but that are too long to meet the organization's internal investment criteria.*
According to their head of technical administration, Roland Larrson, for Akademiska Hus i Lund access to capital is not a critical issue for their implementation of energy efficiency investments. According to Akademiska Hus employee Stig Hoff, payback times for investments taken by the Akademiska Hus organization for all of Sweden generally fall between three to five years, although they can run as long as eight to ten years. The longest payback times that ESCOs interviewed in this study underwent for their projects as a whole was about 10 years.

Conclusion
These two pieces of information would seem to indicate that the requirements for payback times by Akademiska Hus are relatively similar to an ESCO that takes longer payback receives longer payback times, however, this is not enough information provide further analysis.

Planned Effective Partnership - *The organization should have an interest in developing its own staff*
Akademiska Hus recently educated their technicians in auditing and energy efficiency. This is an indicator that they have an interest in developing their own staff, particularly in regard to energy efficiency issues.

One of the ways that Akademiska Hus' staff is being developed is with their increasing cooperation with Lunds Energi, as demonstrated by the "house meetings." Currently, there are two meetings per semester between Akademiska Hus representatives and tenants and others involved with each building. Building issues are discussed at these meetings including, burglars, waste management, maintenance, environmental issues and working safety issues. The people who typically attend to these meetings are the person in charge of building issues

[56] Roland Larsson and Philip Altenhammar. Personal Interview.

from the department, an employee representative on safety issues, housekeepers, janitors, and the house manager or facility manager if one exists. One of Akademiska Hus's managers is present at each of these meetings. According to Kerstin Gustafsson, the house meetings platform has overall been "great" but that "commitment from customers can be much better."[57] In other words, what has occurred in this area has worked out well, but there is also room for improvement.

Conclusion

An opportunity that an ESCO might provide for Akademiska Hus is that hiring an ESCO might serve to further develop their staff in a more cost effective way. A possible threat for Akademiska Hus in hiring an ESCO would be that this would interfere with their existing collaborative relationship with Lund University, or make this relationship unnecessarily complicated.

Akademiska Hus - Conclusions

Given all of these strengths in the implementation of energy efficiency projects Roland Larrson stated that the area where an ESCO could provide useful resources would not be in financing or adjusting of their existing energy systems. According to Stig Hoff, payback times for investments taken by the Akademiska Hus organization for all of Sweden generally fall between three to five years, although they can run as long as eight to ten years. The longest payback times that ESCOs interviewed in this study underwent for their projects as a whole was about 10 years. Possibly, an ESCO could enable additional energy efficiency projects by providing investment and/or guaranteed savings. However, since Akademiska Hus has the ability to finance and implement energy efficiency measures, it may be most useful for them to gain all of the returns on these investments rather than share savings with an ESCO. One area in which an ESCO might provide a valuable service to Akademiska Hus is in providing technical expertise in the installation of new equipment and avoiding the cost of hiring new staff for a specific project

4.2 Lundafastigheter

Background

Lundafastigheter is a company owned by Lund Municipality with 60 employees[58] that rents out mainly public buildings, including 55 schools and 150 buildings of other kinds such as child care, veteran care, community buildings, libraries, and the town council.[59] Lundafastigheter provides maintenance and necessary upgrades on these buildings. Lundafastigheter manages 503,000 square meters with 10% (50,500 square meters) that Lundafastigheter rents out to other real estate actors.[60]

In terms of energy supply Lunds Municipality receives their heating from the following sources: 65-70% district heating from Lunds Energi, 25% electricity, 20% oil, and 5% from bio-fuel leading to a turnover of around 475 million SEK per year and a total consumption of

[57] Kerstin Gustafsson. Personal Interview.
[58] Lundafastigheter. (2004). Available: http://www.lundafastigheter.lund.se/LundsHemd.nsf/0/ca0bb97d8d15af8ac1256b100045c481?OpenDocument [August 15]
[59] Håkan Segerholm. Personal Interview.
[60] Lundafastigheter. (2004). Available: http://www.lundafastigheter.lund.se/LundsHemd.nsf/0/ca0bb97d8d15af8ac1256b100045c481?OpenDocument [August 15]

around 100,000 MWh.[61] On a square meter basis the annual average consumption for Lundafastigheter's buildings is 200 kWh of heat, 60 kWh of electricity, and 0.4 m^3 of water. Electricity is bought from Lunds Energi, Skånska Energi, and Sydkraft, with the majority coming from Lunds Energi. Costs per year for this different media total 60 million SEK for heating, 15 million for electricity, and 4 million for water consumption.[62] Heating represents a much larger cost when compared with electricity and water costs. Current trends indicate a steady rise in electricity consumption. Heat consumption has been slowly decreasing relative to electricity consumption.[63]

4.2.1 Lundafastigheter – Experience with Energy Efficiency

Energy Savings Potential - *An ESCO customer must have at least a minimum energy savings potential as a percentage of their total energy bill*

Rowan Wright, project leader for Lundafastigheter's Energy Smart Schools Program, has been conducting research on the energy consumption of schools in Lund municipality. The graph below shows 27 schools and their energy consumption in kWh per square meter. Energy consumption here is the sum of electricity, oil, natural gas, and district heating consumption. The black bars show the "expected" energy consumption. Six schools are given a red dot beside them to indicate that their actual February 2003 energy consumption was much higher than it should have been when compared with the "expected" consumption. The "expected" energy consumption (with outside temperature factored in) is an estimate of the predicted energy consumption of a building per meter squared according to the characteristics of the building.[64]

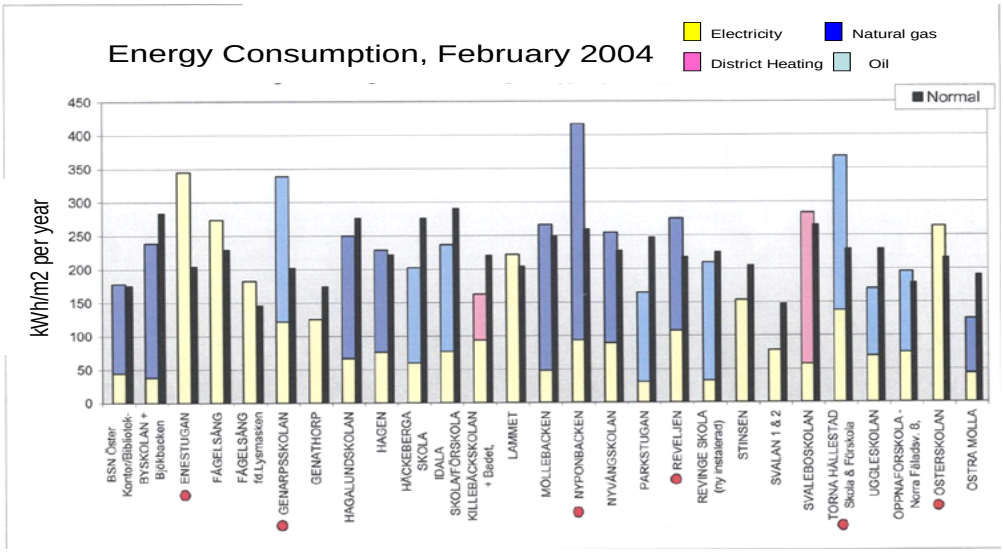

Figure 4-0-3: Actual energy consumption and "expected" energy consumption for 27 schools, all tenants of Lundafastigheter

[61] Håkan Segerholm. Personal Interview.

[62] Håkan Segerholm and Nils-Eric. Powerpoint Presentation (2003/08/12): *Energi i Lundafastigheter: Lundafastigheter i förändring.*.

[63] Rowan Wright. Personal Interview.

[64] The most relevant building characteristic here, basic heat, is calculated using the following variables: the type of heating (e.g. oil or district heating), the type of ventilation system, whether or not a kitchen makes its own food or relies on processed food, if there is a sports facility, and the age of the building (Rowan Wright. Personal Interview.)

An example of this strategy has been the education of key persons, such as janitors, in energy efficiency. According to empirical evidence done by Håkan Segerholm and Rowan Wright, once this education has occurred 5-10% of current energy use can be saved by the re-adjustment of current systems. Some examples of these measures are turning off lights, lowering intake of air (not flow), shorter operation time for fans and pumps, and lowering room temperature.[65] Shorter operation time for fans and pumps has been by far the most energy reducing of these measures.[66] Since Lundafastigheter spends approximately 79 million SEK per year on energy consumption per year, an energy savings of 5-10% per year would yield 4 to 8 million SEK per year.

Conclusion

According to empirical evidence from research by Håkan Segerholm and Rowan Wright, once this education has occurred 5-10% of current energy use can be saved by the re-adjustment of current systems. It is unknown, by this study, how much of these potential savings have been realized. . A survey of 27 schools revealed that at least six of these schools are likely to have significant energy savings potentials from the difference between the actual and "expected" energy consumption in these buildings. No additional numbers were given in regard to Lundafastigheter's energy savings potentials.

Capacities - *The customer must have a relatively lower non-financial capacity (e.g. staff and technical expertise) than the ESCO in implementing an energy efficiency project that is significant enough to demand the ESCO's services.*

Lundafastigheter has four staff members working on energy issues with their buildings. The environmental coordinator works with routines and educational programs.[67] One staff member works on promoting energy efficiency in the schools and doing analysis of school energy consumption. Two staff members are engineers that help operate and maintain buildings. They work on replacing aging systems, such windows or insulation, with new technical solutions.[68]

Energy Billing Structure

Lundafastigheter engineer Håkan Segerholm named the three most important barriers to greater energy efficiency in municipality buildings as being a lack of knowledge, the price of energy being too low, and a lack of incentives.[69] The last of these barriers given by Mr. Segerholm can be illustrated by describing Lundafastigheter's current and future rent and energy billing structures, shown in figure 4-1 below. In both billing systems Lundafastigheter charges their tenants for rent. Under the current system, energy payments are not included in the rent paid to Lundafastigheter. Lundafastigheter's tenants currently pay their heat and electricity bills directly to energy retailers. According to Rowan Wright, if tenants use more or less energy in a given month Lund Municipality gives them this amount irregardless of the amount of energy they use. In other words, tenants do not receive any added costs if they use more energy, or reduced costs if they use less energy through behavior changes or make investments in order to achieve greater energy efficiency.

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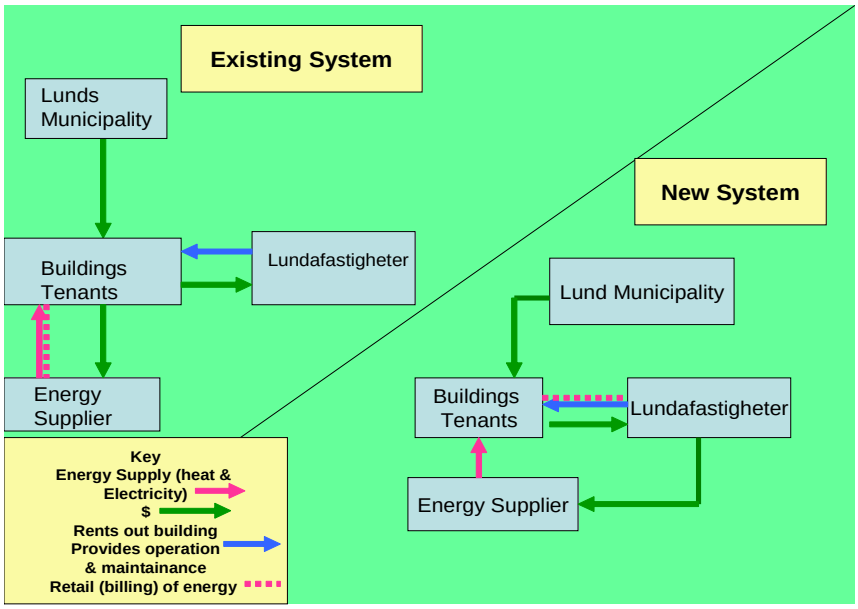
[65] Håkan Segerholm and Nils-Eric. Powerpoint Presentation (2003/08/12): *Energi i Lundafastigheter: Lundafastigheter i förändring.*.
[66] Rowan Wright. Personal Interview.
[67] Rowan Wright. Personal Interview.
[68] Håkan Segerholm. Personal Interview.
[69] Håkan Segerholm. Personal Interview.

Judging from the above description and the representation given in Figure 4-1, two barriers exist in Lundafastigheter's billing structure for achieving greater energy efficiency in its buildings. First, Lundafastigheter is not given any financial incentives for reducing energy in their buildings. Secondly, Lundafastigheter's tenants also do have a financial incentive to reduce energy use as they are not given the monetary result of their energy savings. This is what is regarded as split incentives, when neither tenants nor a building's owner/operator/investor have an incentive to invest in energy efficiency as the billing structure does not allow them to adequately recover and profit from this investment.

A new billing structure for electricity and heating will start in January of 2005. Under the new system tenants will include their energy payments in their rent payment to Lundafastigheter. This change is represented by a dotted pink line. Additionally, Lundafastigheter will take this money and pay the energy suppliers, represented by the green line. According to Rowan Wright, giving Lundafastigheter control over paying energy bills to energy retailers is a positive step. This is because Lundafastigheter's buildings are within their core competence whereas the tenants' core competence resides in their occupations rather than in the buildings themselves.[70] The new billing structure is predicted to give Lundafastigheter incentive to reduce energy in their buildings because they now collect bills from their customers and pay them to energy retailers, giving them the ability to capture energy savings. These savings can be used to finance investments in energy efficiency.

Will this new rate structure help alleviate the second barrier to increased energy efficiency in the energy billing structure, the lack of incentive for tenants to reduce energy? According to Rowan Wright, it remains to be seen how much of any energy savings will be captured by tenants, however, Mr Wright commented that he is optimistic that this will occur.



Source: This diagram was drawn by Lundafastigheter employee Rowan Wright Lundafastigheter and the author

Knowledge of Energy Consumption

[70] Rowan Wright. Personal Interview.

Lundafastigheter does not currently know which parts of its buildings consume the most energy. Additionally, little monitoring and verification occurs concerning the effectiveness of capital improvements made to buildings. Lundafastigheter is taking steps, however, to improve their knowledge of the energy use within their buildings. In order to determine hourly or daily energy consumption in their buildings Lundafastigheter needs to send out an employee to manually read their electricity meters.[71] One reason for this lack of knowledge of the energy consumption within their buildings is the discrepancy between labelling systems for their meters. Lundafastigheter has sets of codes for their meters which correspond to different buildings from its previous supplier. Lundafastigheter switched to Lunds Energi for its electricity retail in 1996 and Lunds Energi used a new set of codes to correspond to each of the electricity meters on Lundafastigheter's buildings. The two sets of codes made by the two different electricity retailers are sometimes hard to decipher. One set may represent the address from one side of the building while another code may represent another side of the same building.[72]

This situation will change in 2009 when the distributor or grid operator will be required to supply these meters, at a cost to the customer.[73] In the meantime Lundafastigheter is planning ahead by bidding between 3 suppliers of meters. For this reason they now have 6 automatic meters (2 for each bidding company), one each for six of their buildings.[74] Lundafastigheter plans to use the information gathered from these meters to set up a database to monitor energy consumption for its different buildings. After this point they will decide which energy efficient improvements will represent the best investments.[75]

Besides metering, one way of knowing more about a building's energy consumption is through historical knowledge. The previous operator of Lund municipality's buildings, along with many organizations in Sweden, undertook many energy efficiency measures in the 1970s. For example, during the late 1970s many building operators reduced the amount of ventilation given to buildings in order to save energy. In some cases these buildings experienced problems with humidity and indoor air quality from these reductions in ventilation. It would be useful to know now at which level of ventilation reduction these buildings started experiencing problems, which could be used to help determine an optimal level of ventilation. Unfortunately, the information gained from the trial and error energy savings measures from the 1970s has mostly been lost.[76]

Energy Efficiency – Adjustments to Existing Systems and Equipment

The focus of Lundafastigheter's efforts toward realizing greater energy efficiency has generally been the use of existing resources. In his school education programs Rowan Wright states that the involvement from inside the school is essential. The two key players that must be on board, according to Rowan, are the school janitor and the head director. Janitors have varying levels of knowledge and interest in energy issues. At best, the janitor is knowledgeable and interested in these issues and can quickly point out ventilation systems that are not working

[71] Rowan Wright. Personal Interview.
[72] Rowan Wright. Personal Interview.
[73] Rowan Wright. Personal Interview.

[74] Water meters were looked into but it was determined that water was too cheap to justify any savings.

[75] Håkan Segerholm. Personal Interview.
[76] Rowan Wright. Personal Interview.

properly, things which are turned on or at improper levels during off hours, old lighting systems, and the temperature of the buildings.[77]

To take the school system (K-16) as an example, there exists a great deal of variability in the interest in energy efficiency among staff. Some schools have been able to save energy through "dedicated and charismatic teachers." They have been the driving force behind some initiatives and have changed energy usage patterns from the inside.[78]

Conclusion

Lundafastigheter's core knowledge in terms of reducing energy use is in the adjustment of existing systems. An ESCO could add to this existing knowledge and most importantly provide capacity in the area of replacing systems with newer ones.

Financing - *The potential customer should have significant possible energy efficiency investments with payback times that an ESCO would be willing to take, but that are too long to meet the organization's internal investment criteria.*

Capital investments in Lundafastigheter's buildings are generally made for the purpose of keeping up the buildings rather than investing in energy efficient cost-reducing measures.[79] The decision on whether or not to make capital investments reflects yearly budgets, needs of the buildings and of the people within those buildings, laws, and complaints that are received. For example, this year all refrigerators that were using a recently banned coolant were replaced. This kind of necessary investment, in this case due to laws, receives priority over one in energy efficiency. When investments in energy efficiency are given funding, one barrier toward receiving and sustaining this funding, according to Rowan Wright, is the limitation of dealing with the short term interest of political cycles. Since municipal cycles revolve in 4 years this poses as an obstacle for generating more long range plans.[80] Additionally, taking schools as an example, decisions can take a while to be made. In the school system it may take three meetings to make a decision to approve a decision after meetings have been held first at the school, then in proposing the budget, and finally for approval by the school board.[81]

Despite the barriers listed above capital investments by Lundafastigheter in measures that reduce energy use do occur. For example, the newer "självdråg" ventilation systems have been installed in some of Lundafastigheter's buildings. In many buildings with these new ventilation systems, the kWh per m^2 electricity used in buildings has been reduced from approximately 200 KWh\$m^2$ to 100 KWh\$m^2$ when these systems have replaced older ones.[82] Additionally, there is now a fund of 10 million SEK that is available for loans for schools to use for energy efficiency measures. Schools have to first demonstrate that they have a worthy investment and then they can receive this funding.[83]

Conclusion

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[77] Rowan Wright. Personal Interview.
[78] Rowan Wright. Personal Interview.
[79] Rowan Wright and Håkan Segerholm. Personal Interview.
[80] Rowan Wright. Personal Interview.
[81] Rowan Wright. Personal Interview.
[82] Rowan Wright. Personal Interview.
[83] Rowan Wright. Personal Interview.

Lundafastigheter is already gaining greater energy efficiency by adjusting their existing equipment and systems through activities such as education of key employees and the related shortening of operating times for fans and pumps. Since capital investments are now often made only when equipment needs to be replaced (not as calculated investments according to their payback times), an ESCO could provide assistance to this organization by financing and implementing the replacement of new equipment and systems.

Planned Effective Partnership - *The organization should have an interest in developing its own staff*
The focus of Lundafastigheter's efforts toward achieving greater energy efficiency has been the use of existing resources, including the training of their staff. Therefore, Lundafastigheter is already doing one of the services that an ESCO would provide, however, an ESCO could provide this service without cost.

Lundafastigheter - Conclusions

Lundafastigheter is focusing efforts in achieving greater energy efficiency by utilizing existing resources in their buildings and training their staff. A number of types of investments often receive preference over investments in greater efficiency for financing within Lundafastigheter's buildings. Additionally, the short term political cycle and the corresponding yearly budget changes also serve to put investments in greater energy efficiency on unsteady ground. The consistent and guaranteed financing of an ESCO could provide a solution around factors that are inhibiting the financing of energy efficiency improvements and contribute to their existing efforts in training their staff. The information collected in this study is, however, inconclusive regarding the energy savings potential that an ESCO could help Lundafastigheter realize.

4.3 Region Skåne

Background

Region Skåne is a non-profit government organization with 32,000 employees that mainly encompasses the health care system (also dental care, culture and regional development, including regional public transportation) for the Skåne region of Sweden. Sweden is divided into 21 such districts, or landsting. Sweden is governed by a parliament and run by a federal system in the health-care area. This system is 100% tax financed, only a small part (a few %) is private health care. Most of these landsting are running at a deficit. From a facilities management point of view, the organization of Region Skåne is divided in tenants that focus on their main professions and a landlord that focuses on supplying the most cost-effective and adapted buildings to the tenants.[84]

This real estate section of the organization, RegionFastigheter, rents out buildings to other section of the organization. It administers 1.39 million square meters making it the 3rd largest real estate organisation in the among landsting organizations. RegionFastigheter administers 405,000 m^2 in Lund, the largest hospital building being 130,000 m^2 (RegionFastigheter 2002).

RegionFastigheter has an annual turnover of 1.5 billion SEK out of which 200 million SEK is from energy related costs. One-half of these costs are from heat and one-half from electricity. District heating and district cooling are both provided by Lunds Energi. RegionFastigheter is allowed to have their rent cover their costs, which is quite unusual compared with the private

[84] Robert Johansen. Personal Interview.

market. The annual turn-over for the organization is close 26 million SEK.[85] RegionFastigheter rents are very low. According to Robert Johansson, this is due to the principles for computing the rent in Region Skåne. Since most buildings are more than 30 years old, the cost of capital is zero. Everything is included in the rent, including heat and electricity. Rents are on average 600 SEK per m^2 per year, much less than typical Lund rents. Low rents are typical for all of the Landstings as none of them offers rents over 900 SEK per m^2 per year.[86]

4.3.1 Region Skåne – Experience with Energy Efficiency

Financing - *The potential customer should have significant possible energy efficiency investments with payback times that an ESCO would be willing to take, but that are too long to meet the organization's internal investment criteria.*

The total building stock of Region Skåne is worth 5 billion SEK. Right now there is 10 million allocated for profitable investments in buildings. For the entire region, Region Skåne averages a maintenance budget of 70 SEK m^2. This is very low given that it covers all areas including costs for the structure, surface, rust, etc.[87] Region Skåne has strict regulations regarding their investments. Politicians are aware of the deficits that the organization is facing, but as money is scarce investments in equipment for the organization's core area of medicine are given priority of energy or facility related investments. One of the ways of financing investments in reduction of energy consumption is the market mimicking "profitable investment", which must be less than 5 million SEK and must pay off within 4 years. The restrictions, however seriously limits the array of available options as it excludes most solutions that involve system-wide modifications, which is where the largest potential lies.[88]

Another potential way out of the barrier to larger investments with longer payback times would be for Region Skåne to take out a loan. The reason why this is not likely is exclusively because it would not go well politically for Region Skåne to take out large loans. The level of debt that Region Skåne and other landsting are in is not at all alarming compared to many private corporations of the same size, but, this action would not likely be seen as favourable to the electorate. Facing this virtual shortage of money, investment in medical equipment gets priority over investments in buildings.[89]

Energy Savings Potential - *An ESCO customer must have at least a minimum energy savings potential as a percentage of their total energy bill*

RegionFastigheter employee Robert Johansson stated that "anybody can see that the potential is there" concerning the potential for energy savings in their buildings. Most of their buildings, including the ones in Lund, were built between 1968 and 1975 when "energy cost was not an issue." The Lund hospital was built in 1968 and "basically nothing has changed since.[90]" To illustrate that high energy consumption of these buildings is due to historical construction trends and not conditions within Region Skåne, Mr. Johansson used the example of the new children and youth hospital built by Region Skåne in Lund in 2000. This hospital uses state of the art technology. Also, the heating and cooling system in the hospital of Kristianstad, built in the early seventies has been modified and now utilises large-scale heat-pump technology combined with the use of a large subterranean aquifer that is used to store

[85] Robert Johansen. E-mail correspondence.
[86] Robert Johansen. Personal Interview.
[87] Robert Johansen. Personal Interview.
[88] Robert Johansen. E-mail Correspondence.
[89] Robert Johansen. Personal Interview.
[90] Robert Johansen. Personal Interview.

and recover excess heat. Not much is known about which areas of Region Skåne's buildings consume the most energy. Robert Johansson made the general observation for most of Region Skåne's buildings that they "decaying" due to a general lack of investment and renewal in these buildings. For example, the major ventilation systems in the main building in Lund have operated around the clock for 35 years without renewal. Ventilation systems usually do not run past 20-25 years without being subject to major renewal. Due to the aging infrastructure, Mr. Johansson states that "there is a large potential for making profitable investments."[91]

Capacities - *The customer must have a relatively lower non-financial capacity (e.g. staff and technical expertise) than the ESCO in implementing an energy efficiency project that is significant enough to demand the ESCO's services*

Three-hundred and fifty people work for RegionFastigheter throughout the entire region. These can be broken down into 270 employees as technicians and for maintenance, 30-35 in business administration, and 25-30 in project management.[92]

Energy Billing Structure

RegionFastigheter buys electricity on the Nordpool market through the contracted broker Sydkraft AB on 3, 6 and 12 month terms as well as on the spot market, and buys their district-cooling and -heating from local suppliers such as Lunds Energi. RegionFastigheter sign a contract with their tenants every year. Assumptions are made concerning their costs such as insurance, maintenance, and energy use. In the case that tenants decrease or increase their energy consumption in a particular year, then their rent may be adjusted accordingly the next year. According to Robert Johansson, the lead time of this rate structure gives tenants "little or no motive to lower energy consumption."[93] The billing structure of Region Skåne may be regarded as not a strict case of split incentives, since Region Skåne can lower its costs by investing in energy efficiency improvements, but does not due to strict investment rules. However, in practice this billing structure functions like split incentives since neither the tenants nor the owner/operator/investor have an incentive to invest in energy efficiency improvements.

A new rate structure will come into being next year. In this new rate structure RegionFastigheter will also forecast energy consumption and price as with the previous rate structure. This time, however, tenants will pay only for the energy actually consumed during the year. Thus, deviations from the forecast will be regulated at the end of the fiscal year. The plan is that the areas that save energy will gain this money back and that it will not go to other departments. This is believed in spite of some technical barriers to be mentioned in the next paragraph. As has been already explained, Region Skåne is under pressure to reduce their costs so that they can balance their budget. A clear piece of evidence that Region Skåne Fastigheter's tenants are anticipating the new rate structure is that many of them have already reduced their budgets in anticipation of their ability to reduce costs as a result of this behavior![94]

[91] Robert Johansen. Personal Interview.

[92] Robert Johansen. Personal Interview.

[93] Robert Johansen. Personal Interview.

[94] Robert Johansen. Personal Interview.

The budget of RegionFastigheter's tenants is fixed. In order to realize their savings and spend it on other things tenants would need to know or predict these savings ahead of time. In order to make this system operate this would require RegionFastigheter to show month by month energy consumption in advance.[95] Unfortunately, one of the stated factors for this new rate structure to succeed, a month by month recording and reporting of energy use, will just barely be launched at the time this new rate structure comes into play.[96]

Barriers to knowledge of energy consumption

There are a number of reasons why the monthly energy consumption per building is not known. The most basic reason for this is that, according to Robert Johansson, "most of our buildings were designed during an era of low energy-costs, so their infrastructure was not built to be monitored; it was built to give us low building cost." RegionFastigheter has a main customer meter for heat, electricity, and water. In all three of these cases RegionFastigheter is represented as one customer for suppliers of these media. These three meters have a statistically sound database. In a lot of areas they have in house meters; however, these in house meters have in most cases a variety of problems. The in-house meters often have not been neither calibrated nor been logged, and in many cases it is not known which meter represents which building. Additionally, the ability to accurately control energy use lessens with time as tenants move around more frequently now and with every new tenant the climate-controlling parameters have to be changed and new air- and heat-balances have to be set, but the organization has not been able to keep up or keep track. When tenants move out settings have to be changed but the organization has not been able to keep up or keep track.[97]

Planned Effective Partnership - *The organization should have an interest in developing its own staff*
Another important factor is mentality. In many cases someone has to go out and manually read and record heat and electricity meters. According to Robert Johansen, at the moment there is a perceived lack of motivation on the part of some employees to do this as there has not yet been much evidence that the results of their work have been put to use. In addition to a perceived lack of motivation, there is also an organizational barrier in that the person in charge of the budget for energy is not in charge of the employees who do the actual registration of the readings. At the end of 2004 as a new organisation will be set to help alleviate this problem. At the same time RegionFastigheter will also employ an energy strategist. [98]

Performance Contracting Project

Region Skåne has decided to use performance contracting for their branches in Lund, Helsinbörg, and Kristianstad. The final contract has to be verified with the ESCO TAC and the idea still needs to be sold to Region Skåne's board, but otherwise the concept is in place.[99]

The organization's interest in performance contracting goes back a few years starting with brief contacts with companies seeking to expand their markets into the public field.[100] Early in 2003 Mr. Johansson says that RegionFastigheter attempted to start a bid process for performance contracting but this stopped because at the time they were understaffed. Later

[95] Robert Johansen. Personal Interview.
[96] Robert Johansen. Personal Interview.
[97] Robert Johansen. Personal Interview.
[98] Robert Johansen. Personal Interview.
[99] Robert Johansen. Personal Interview.
[100] Robert Johansen. Personal Interview.

the same year Mr. Johansson had found a colleague to help him with the project and it was realised.[101]

One of the barriers that Region Skåne came across in doing this was the Swedish law of public procurement. According to Robert Johansson many of those acting under this law are uncertain about how it works. Mr. Johansen explained that the law itself is not very extensive, but the surrounding literature is, amendments are frequent, praxis is lacking and settlements are costly. He speculated that this may be one reason why more government organizations do not use performance contracting in Sweden.[102]

One of the difficulties in using the performance contracting concept with the public procurement law is that it is difficult to say exactly what it is that one wants to buy. In a performance contract one is not exactly sure what measures will be implemented sometimes well into the process, long after a company has been hired. To overcome this issue Region Skåne sent out a bid based less on a certain product but rather more for the service they wanted.

According to Robert Johansson the most urgent question was:

How do we state our expectations so that we can choose the best entrepreneur when not even we know exactly what to expect? Under the law you have to be specific in what you want to buy and you must no allow room for subjective and personal evaluations.

Instead of specifying a product or process they first stated what they have in terms of costs, energy consumption, and buildings. Next they asked their potential ESCOs what they could produce for them in terms of costs, qualifications, financing, and what business total business model this would entail. Some additional criteria were that there had to be a pay back in 7 years, Region Skåne would have to be free to operate its own buildings, and the ESCO would have to educate Region Skåne employees on the changes they make. Finally, Region Skåne specified that it must own whatever equipment is installed as soon as it was installed.[103]

Region Skåne has chosen TAC out of 6 applicants and 3 pre-qualified applicants to do the job. All three pre-qualified applicants estimated a project cost of 40- 50 million. In all cases this was given to be conservative. Costs may go as high as 100 million. TAC estimates that this project will save Region Skåne about 7.5 million SEK per year, which equals 13% of the energy use in the specified buildings. Since this does not count the amount of the savings that TAC will receive then energy savings probably run at 18% per year, assuming that TAC takes 5-7% of the savings.[104]

TAC will make a specified offer in October 2004. Between April and October, TAC will gather statistics and look at equipment to see what equipment they want to work with and to make a final offer. Surprisingly, after TAC makes this offer Region Skåne still has the option of conducting the work themselves.[105]

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[101] Robert Johansen. Personal Interview.

[102] Robert Johansen. Personal Interview.

[103] Robert Johansen. Personal Interview.

[104] Robert Johansen. Personal Interview.

[105] Robert Johansen. Personal Interview.

TAC will provide a performance guarantee for energy savings. If the outputs of their installations do not make this guarantee then TAC will pay the difference. The installed equipment will be given a 5 year guarantee, however, since the payback time of the installed measures will be around 7 years then this can serve as a defacto seven year guarantee. Under the contract terms Region Skåne is obliged to maintain equipment at a certain level. They are given a maintenance sheet of instructions and measures with requirements for different pieces of equipment. TAC must educate Region Skåne employees in necessary areas. In this way the relationship can be seen as one of co-dependence. TAC needs Region Skåne to maintain its equipment correctly or this equipment will not perform in accordance with energy savings predictions. For this reason TAC must educate Region Skåne employees and make sure they are maintaining their facility. On the other hand, Region Skåne needs TAC to educate them in the new equipment or else they will neither know how to properly operate this equipment during the time of the performance contract nor how to maintain its output afterwards.[106]

The success of this project will be determined by energy savings. These will be converted to monetary values. A price will be fixed for energy. Baseline energy consumption will be calculated using an average weather year. Every six months TAC and Region Skåne will meet to discuss what changes have occurred in the buildings. If the measures perform better than expected then the profits will be split. Monitoring of behavior within the buildings will not occur beyond the general reporting that happens every six months. According to Robert Johansson, a greater amount of monitoring of building occupancy would be a difficult task even just at the hospital in Lund, representing 8,000 people dispersed over all hours of the day. Major machines will be monitored such as fans for ventilation. It is considered too much work to monitor smaller devices such as the 4,000 computers present in hospital.

The financial conditions of this ESCO project can be estimated to illustrate to the reader projected numbers for an estimated actual ESCO project. The cost can be assumed to be 50 million SEK, the cost given by TAC and the other ESCOs in their bid, and will last seven 7 years, the time stipulated by Region Skåne. In order to recover costs of 50 million SEK approximately 9 million SEK would have to be saved per year. The project covers 400,000 square meters. The annual energy cost for the buildings included in the ESCO project is 60 million SEK. Recovering the costs of a 50 million SEK investment over a period of seven years with an interest rate of 7% would call for energy savings worth 9 million or 15% per year.

Region Skåne saves less money from not financing this project themselves. According to estimations by Robert Johansson, if Region Skåne were to finance the project the interest rate would probably be less than half. This would reduce the costs of financing by approximately one million SEK per year. Under this scenario, Mr. Johansson calculates that Region Skåne saves one million SEK less per year. Even so Mr Johansen is quite satisfied with the situation, seeing as the alternative is saving nothing at all.[107]

Region Skåne - Conclusions

Region Skåne is an organization with old buildings that have been kept up with a low level of maintenance. The organization lacks an understanding of its energy consumption. This comes from technical, organizational, and social barriers, and due to the fact that employees in many cases do not have enough time to deal with these issues. An important organizational

[106] Robert Johasen. Personal Interview.

[107] Robert Johansen. Personal Interview.

barrier to increased energy efficiency, as already stated, is that even without social and technical barriers Region Skåne employees in most cases would not have the time to take care of energy problems. Finally, as a government organization, Region Skåne has a very good credit rating. In short, Region Skåne has a lack of internal capacity to deal with energy issues, a high energy savings potential, and a lack of ability to finance these needed energy savings. All the factors listed above make Region Skåne an ideal candidate for the use of an ESCO's services.

5 Lunds Energi

This section will analyze the potential for Lunds Energi to become an ESCO. This analysis will fall under the general area of the qualitative development of Swedish ESCO market to include energy retail suppliers as suppliers in this market. This will be done by first providing a background on the potential for an energy retail supplier to deliver energy efficiency services in the general and Swedish cases (5.1), and a description of Lunds Energi's business (5.2). Next, Lunds Energi will be analyzed for its potential to become an ESCO by first evaluating six potential ways that Lunds Energi can profit from providing their customers energy efficiency services. Next, the evaluation criteria from Section 2 will be used to evaluate Lunds Energi as a potential ESCO.

5.1 Swedish Utilities and Energy Efficiency Services

Energy efficiency is generally faster than energy supply in reaching the market, especially when compared with big centralized power plants (Lovins 2002). It is also cheaper. In the EU, it is estimated that the average cost of saving a unit of off-peak electricity in the domestic sector is around 2.6 eurocents/kWh, compared to the average off-peak price for delivered electricity of 3.9 eurocents. The average on-peak price for electricity is about 10.2 euro cents/kWh (Commission Proposal COM(2003)739 final). The difference between the cost of buying energy and saving energy is only likely to increase in the future. Fossil fuels, such as natural gas and oil, will become more expensive to supply due to the diminishing returns in extracting these resources. Additionally, policy measures such as CO_2 trading permits will also likely also increase the price of these fuels.

In addition to the cost of savings energy often being less than producing it, there are other benefits for an energy retail supplier to assist their customers in reducing their energy use. Some examples of such benefits are given by the Wuppertal Institute (2000 p. 2) SAVE study[108]. An energy retail supplier is an energy company, such as Lunds Energi, that produces and sells energy. Benefits #1 and #5 below can only be gained by an actor that produces and sells energy, a retail supplier, and not by companies that only serve as retailers. Of course, some companies may fit between these two distinctions, as is the case with Lunds Energi, a retail supplier of district heating and electricity retailer.

1. Avoiding new generation capacity
2. Avoiding costly peak power purchase
3. Selling energy efficiency services to customers or other market actors
4. Increasing the loyalty of existing customers and/or adding new customers by providing an added value to services
5. Fuel switching to the type offered by the energy company

Despite these advantages, according to the same Wuppertal Institute report "empirical evidence" demonstrates that in general energy companies have given energy efficiency

[108] SAVE is an EU programme aimed at promoting non-technical action toward achieving greater energy efficiency.

services[109] in liberalized energy markets (Wuppertal Institute 2000 p. 2). One factor that favors supply side investments is the fact that in most cases utilities are able to receive lower interest rates on investments in energy supply, while energy users receive higher interest rates on investments in reducing their demand for energy (Wuppertal Institute 2000, p.32). These lower interest rates can be explained as one factor why, according to Lovins (1997), observing primarily about the US experience, the payback times that utilities will take for investments in production can run from 20 to 30 years. These are much longer payback time times than consumers or presumably energy suppliers would be willing to take for demand side investments.

A basic obstacle for a retailer supplier to provide energy efficiency services is that this goes against one of the fundamental goals of these companies, to increase energy sales. According to the Wuppertal Institute (2000, p.42-43), the benefits gained by an energy retail supplier in providing energy efficiency services must be greater than the costs associated with providing these services and the lost revenues from energy sales in order for this option to be financially attractive.

In a deregulated market where customers can switch energy suppliers, retail competition can make the sale of energy efficiency services by energy suppliers even more difficult. Since customers can switch retailers, energy efficiency services that are financed by placing costs into customer bills become much harder to accomplish because customers can switch retailers at any moment on the basis of price.

According to a Wuppertal Institute (2000, p. 33) SAVE program study:

This contributes to a more short-term perspective on any resources, which favors resources with low capital investment over resources with a higher initial investment but lower running costs (e.g. demand side efficiency). The lower prices are mostly a result of competition in generation, in turn, contribute to a more short-term perspective on the customer side as well, reducing the awareness of demand-side energy efficiency options.

This general trend described in the above quote is also taking place in Sweden. According to the IEA DSM Tax X Performance Contacting Country Report on Sweden, since deregulation began in Sweden in 1996 (IEA 2001), the profit margin on the sale of electricity has decreased substantially. Meanwhile, profit margins on production are relatively larger. Since the sale of electricity has such low margins, there is little room to incorporate value added services such as energy efficiency services. Instead, companies compete on price (IEA 2001). Nether of these reports give similar observations on trends in district heating markets. According another SAVE study conducted by the Wuppertal Institute (2003):

There is no established/mature energy efficiency services market in Sweden. The energy company interest in marketing energy efficiency services has faded in the last 2-3 years although probably all suppliers offers some energy efficiency services.

Two employees of the energy company Vattenfall and one retired employee of the energy company Sydkaft were asked to comment on why energy retail suppliers are not providing more energy efficiency services in the deregulated market. Vattenfall and Sydkraft are two of the largest energy companies in Sweden. A list of some of the observations of these

[109] The report uses the term energy efficiency demand side management, a broader term that includes energy efficiency services, and other areas such as energy efficiency programmes, when the customer does not pay directly to the provider (Wuppertal Institute 2000).

respondents is given below. A distinction between heat and electricity is provided when interviewees made this distinction.

- Energy companies view demand-side measures as benefiting public relations and other areas. They are often not viewed with full seriousness as stand-alone profitable business investments.[110] This observation might explain why, according to a survey done by Strid and Bergsmath (2004), Swedish energy companies do not verify the success of 91% of their energy efficiency services.
- Investments in energy production receive low payback time requirements that are less than payback times would be than for investments in energy efficiency services, which differs from the observations of Lovins (1997) given on the previous page.[111]
- Higher emphasis is placed on profits from company ownership and as a result of changes in company culture and changes to society in general.[112]
- General energy company culture remains focused on the sale of energy.[113]
- 10-20 years ago services associated with energy efficiency were often given a part of a total package by energy companies. Thus, customers are historically accustomed to receiving these services at no cost. This historical factor inhibits the present demand customer demand for energy efficiency services.[114]
- During the beginning of the deregulation of the Swedish energy market from 1996 to 2003, Vattenfall, was focusing on value added services such as providing services related to energy efficiency, such as projects in "smart homes", selling total energy solutions (see pg. 78), and other areas. After this period, Vattenfall chose to change its strategy to concentrate on changing from expanding more deeply within the Swedish market to concentrating on expanding on a geographic basis outside of Sweden. This change in strategy was a major reason for them to cut many of their value added services. According to Thomas Davey, Vattenfall, one of the energy market leaders, can be viewed as a trend-setter. Once Vattenfall dropped some of their value added services some other companies followed suit[115]
- Historically low energy prices
- Subsidies are given to municipal actors in the form of lower district heating prices[116]

In the US case, utilities have often acquired existing ESCOs. However, the World Energy Efficiency Association writes wrote in 1995 in its *Briefing Paper on Energy Efficiency Companies* that it is "quite rare" for utilities to create ESCOs (WEEA 1995). No evidence was found in literature to suggest that this situation has changed in the last decade. A global perspective on energy efficiency services undertaken by energy suppliers and retailers is outside of the scope of this paper.

5.2 Lunds Energi's Business

This section will serve to provide background information for the next sub-section on evaluating Lunds Energi as a potential ESCO.

Lunds Energi is owned 97.5% by Lunds Municipality and 2.5% by Lomma Municipality. The Lunds Energy group offers services within electricity sales, district heating, natural gas supply,

[110] Rolf Henriksson. Personal Correspondence.
[111] Thomas Davey. Personal Interview.
[112] Rolf Henriksson. Personal Correspondence.
[113] Thomas Parker. Personal Correspondence. Rolf Henriksson. Personal Correspondence.
[114] Thomas Davey. Personal Interview.
[115] Thomas Davey. Personal Interview.
[116] Thomas Davey. Personal Interview.

district cooling, IT-communication, service, and contracting. Apart from the holding company Lunds Energy Ltd, the company is divided up into several smaller companies. Lunds Energi will only be evaluated in this section for its businesses in district heating supply and electricity retail.

Lunds Energi has district heating grids in Lund, Eslöv, and Lomma; the majority of which is in Lund. Lunds Energi sells electricity throughout Sweden. Lunds Energi recently merged with Ringsjö Energi, a company about 10-15% the size of Lunds Energi located in Eslöv (IIIEE 2004). Lunds Energi sells electricity throughout Sweden.[117]

Recent Trends

During recent years, Lunds Energi has acquired a few electricity retail companies on a regional level. This has helped Lunds Energi to gain greater competitive edge in obtaining more consumers. At the same time, Lunds Energi is competing in the electricity retail market with fewer but larger players. More and more small-scale companies have been acquired by the dominating players on the market. In 2002, there were 158 electricity suppliers in Sweden. Today there are only around 60. The three largest electricity providers in Sweden, Vattenfall, Fortum/Birka Energi and Sydkraft, together with their wholly or partially owned subsidiaries, have obtained 70% of the total market of sales to end consumers.[118]

Customer Demand for Energy Efficiency Services

The demand for energy efficiency services within Lund was estimated using three methods. The second two methods address the demand for energy efficiency services if Lund Energi is the provider of these services. First, the Lund local energy advisor Björn Alm was asked how often he received questions concerning energy efficiency measures. Secondly, Lunds Energi employees were asked to describe their organization's experience with energy efficiency.

Björn Alm, the Lund municipality energy advisor, answers telephone calls from Lund residents and organizations with questions concerning energy supply and demand. His calls mostly come from houses, but he also receives some calls from apartments and in rare cases from industry. From Mr. Alm's perspective, he said that interest in energy supply information concerning heating is much greater than interest in demand-side measures by those who call him. Mr. Alm receives about 5 calls per day. He estimated that one in ten of these calls are concerning demand-side measures, with the remaining calls concern supply side measures.[119]

Interviews were conducted with six Lunds Energi employees. The question was posed what they perceived the demand by the customers to be for energy efficiency services from Lunds Energi. Lunds Energi employees generally felt that their customers gave the price of both heat and electricity as their primary concern.

Going beyond the issue of the general customer demand for energy efficiency services, the issue of trust in Lunds Energi in successfully delivering the best solutions with these services is analyzed on page 65.

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[117] Lunds Energi sold the following amount of electricity to different sectors in 2003 (GWh): Industry 370.26, Other 404.6, Public 387.09, Apartment Complex 117.81, Small house w/electric heating 302.94, Small house w/o electric heating 100.98, Total 1683

[118] Energimyndigheten. (2004). Available: http://www.stem.se [2004, September 22]

[119] Björn Alm. Personal Interview.

Experience with energy efficiency

Lunds Energi has not been actively involved with providing energy efficiency services to their customers since the mid-90s. In 1996 Lunds Energi arranged for 3 of their customers to receive energy audits. These three customers were a hotel in Helsinbörg and two laundries in Malmö. Audits were outsourced to outside companies. The smaller heat measures, such the use of timers and thermostats, had lower payback times than similar measures used to save electricity, which were often more than 10 years. At this point electricity prices were much lower than they are now so these measures would certainly have shorter payback times now.[120] Some of the recommendations from these audits concerning heat use were undertaken fairly quickly. The longer payback times discouraged the implementation of electricity related measures.[121]

Production facilities for district heating

Lunds Energi has a total maximum capacity of 493 MW for district heating. In 2003 their geothermal production came from 45% geothermal, 45% natural gas, 7% bio-fuel, and from 1% electric boilers.[122] The capacities for Lunds Energi's production of district heating and electricity are listed in Figure 5-1 below. The production of combined heat and power is relevant here as it affects the economics of district heating production. Additionally electricity production is shown here in order to give a more complete picture of Lunds Energi's energy production system.

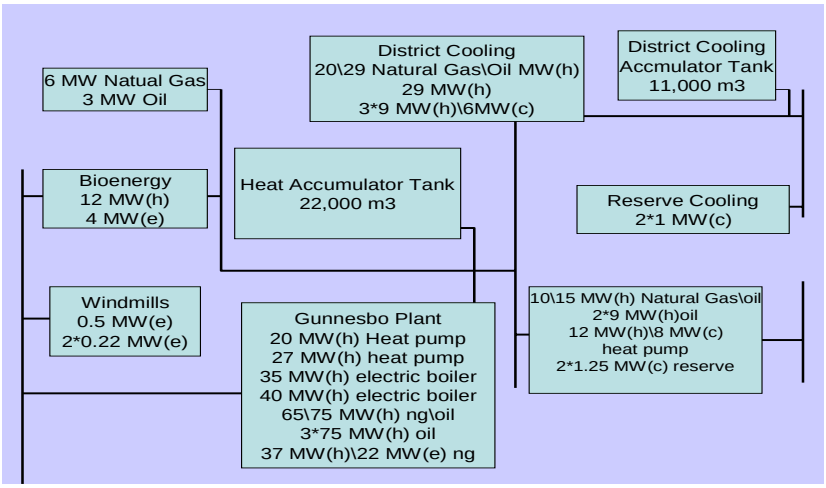

Figure 5-1: District Heat and Electricity Production for Lunds Energi
Source: Lunds Energi. "E" stands for electricity production and "h" stands for heat production, "c" stands for district cooling.

5.4 Lunds Energi as an ESCO?

5.4.1 Strategies for Lunds Energi to profit from energy efficiency

Six potential ways for Lunds Energi to make money if their customers save energy are identified in section as taken from the Wuppertal Institute (2000), the idea of real-time pricing, and potential future policy outcomes. These benefits are reinforcing and can be seen as

[120] Rolf Månsson. Personal Interview.
[121] Rolf Månsson. Personal Interview.
[122] Mats Olsson. E-mail Correspondence.

advantages for an energy supplier such as Lunds Energi to enter the ESCO market over an actor that only concentrates on demand-side measures. Lunds Energi has the potential to gain money from two sides, on the demand side from shared savings with their customers and on the supply side from decreased costs for expensive marginal fuels and avoided investment costs in new capacity. These demand-side factors can increase the value added of their supply of energy and these combined demand and supply side factors can increase the environmental and general profile of the company.

1. Avoiding higher marginal costs for certain fuels or electricity prices

Lunds Energi geothermal wells are always running. In the middle of June or July, two machines are put into maintenance, for 14 days and 5 weeks respectively. If the weather is cold at this time of year then Lunds Energi has to use natural gas and possibly oil.[123] Bioenergy generally is used for about 8 months per year with 4 months given for maintenance. Natural gas is used for about 6 months per year. Finally, oil generally is used for "only a few hours per year" and electricity operates for the same amount of time or not at all.[124] The marginal cost for producing different fuels in district heating production used during different months in 2003 can be seen in Table 4 below.

One can see from the table below that the cost of producing district heating through bioenergy and geothermal is twice as cheap, or more, than producing district heating from oil, natural gas, and electricity. Bioenergy is regarded by Lunds Energi as having a marginal cost close to zero since the electricity that is produced from bioenergy combined heat and power production is mostly consumed internally, thus avoiding the cost of buying it.[125] Geothermal production marginal costs, shown in row 3, take into account the costs of operating the geothermal plant. The fuel cost per MWh for the MWh energy content is given in table C.[126] The value given in column B, on the other hand, represents the cost of producing each MWh once fuel efficiencies and taxes have been included. A fuel efficiency of close to 100% is estimated for all values except for geothermal which generates 3 units of heat for each unit of electricity consumed. The tax for the natural gas turbine's cogeneration production is 21% less than the tax given to natural gas without cogeneration. Maintenance costs are an average for these costs from 2000 to 2003.

[123] Mats Olsson. Personal Interview.

[124] Sigvard Strelert. Personal Interview.

[125] Mats Olsson. Personal Interview.

[126] These numbers below take into account all of the fuel costs. For instance bioenergy fuel here does not only mean wood but also includes wood fuel, sand, limestone, coal, and water (sand, limestone, and coal are used for pollution abatement).

A	B	C	D	E	F
	Cost MWh, Fuel +Tax	Fuel Cost per	Taxes	Maintenance	Total
Bioenergy	120-130		0	101.66	221.66 - 231.66
Geothermal (summer)	150-180 – summer	230-300	215	22.63	172.63 - 202.63
Geothermal (winter)	170-200 – winter	280-350	215	22.63	192.63 - 222.63
Natural Gas	400-430	217.44	197.56	23.19	423.19 - 453.19
Gas Turbine	240-270	218	37	27.79	267.79 - 297.79
Oil	435-455	84.5-114.5	315.5	23.19	458.19 - 478.19
Electrical (summer)	315-465	100-250	215	5-10	320 – 475
Electrical Boiler (winter)	441-591	200-350	241	5-10	446 – 601
Natural Gas Boilers (outside of Lund)	400-430	217.44	197.56	32.33	432.33 – 462.33

Table 3: Marginal Costs in SEK for different district heating sources for Lunds Energi per MWh
Source: Lunds Energi

To provide simpler picture, the average combined fuel and tax prices for Lunds Energi district heating fuels are in SEK per MWh:

Geothermal (summer)	165
Geothermal (winter)	175
Bioenergy	125
Natural Gas (combined heat & power)	255
Natural Gas	415
Oil	445
Electricity (summer)	465
Electricity (winter)	516

This indicates that natural gas, oil, and electricity represent the three fuels where Lunds Energi can save money if their customers use less energy. Approximately 22% of the natural gas production by Lunds Energi is through a natural gas turbine, resulting in the cogeneration of heat and electricity. This cogeneration process and the associated taxes are an average of 160 SEK per MWh cheaper than the other natural gas production (Table 3). Natural gas can always be considered a fuel with a higher marginal cost than the base fuels of geothermal and bioenergy, since natural gas turbine production is still an average of 80 SEK per MWh more expensive than producing heat through geothermal in the winter, and the non-combined heat and power produced natural gas is 270 SEK per MWh more expensive than producing geothermal in the wintertime.

Therefore, the amount of energy that would be needed to save by Lunds Energi customers, using 2003 data, in order to avoid higher marginal cost production is given below. A more visual interpretation is given in figure 5-5. As stated, the majority of natural gas that is not using cogeneration in the Table below represents a more profitable opportunity for saved energy than the natural gas using cogeneration.

Table 4: Amount of Lunds Energi marginal fuels, oil, electricity, and natural gas, that would have to be saved (MWh) per month (2003) in order to use only the base fuels, bio-fuel and geothermal

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Natural gas + Electricity + Oil	96,587	92,795	64,490	37,165	5,684	4,063	3,013	1,001	3,531	45,082	43,344	65,585
Electricity + Oil	10,198	5,205	6,381	17,780	35	105	0	14	0	1,173	2,136	10,245

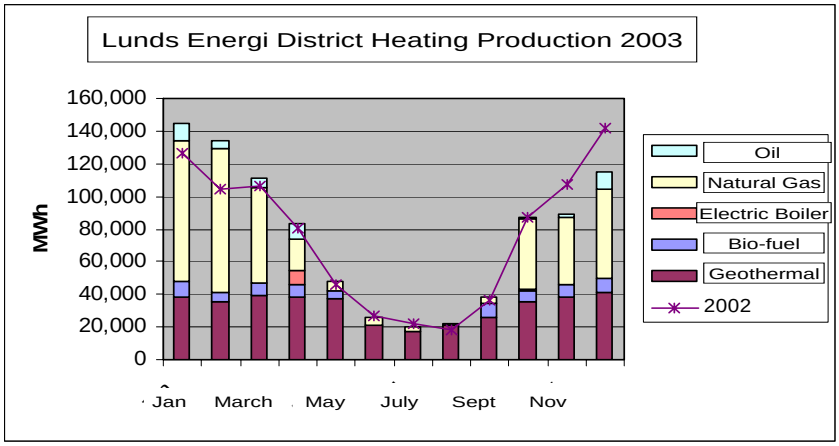

Figure 5-5: Lunds Energi District Heating Production, Different Fuels Used in 2003
Source: Lunds Energi

What do these numbers indicate? To reduce Lunds Energi customers' energy use all the way down to the base loads of bioenergy and geothermal would be quite a formidable task during the wintertime. However, from June through September this would only require a reduction of 4,000 MWh of energy consumed by Lunds Energi customers. To put this number in perspective, Lundafastigheter uses a yearly amount of energy of 100,000 MWh. Empirical evidence shows that education of key persons such as their janitors can usually lower energy consumption in Lundafastigheter's buildings in certain areas by 5-10% simply through improvements in the operation and maintenance of facilities. During the summer months, if such an amount of reduction in energy consumption were to occur by *any* or a combination of Lunds Energi's customers, then this would result in significant financial savings for Lunds Energi as they would not have to produce fuels with higher marginal costs from natural gas, oil, and electricity. Of course, in order to capture these financial savings, reductions in energy consumption would have to rise with increases in consumption by customers. For example, from 2002 to 2003 Lunds Energi district heating production rose by 1.6%.[127]

In the winter months, Lunds Energi customers would have to consume a great deal less energy in order to reduce Lunds Energi's production to its base load fuels of geothermal and bioenergy. However, significant savings can be made during winter months through a switch from the two most marginal fuels, oil and electricity, to natural gas. Throughout the entire year, a lowering of consumption of over 10,000 MWh can accomplish this goal.

2. Avoiding investments in new generating capacity for district heating

According to the Lund Energy Plan (2001) the technical life span of Lunds Energi's geothermal generation is another 30 years, after which point it will start decreasing its

[127] Calculation based on data given by Mats Olsson, e-mail correspondence.

capacity.[128] More relevant to the more short-term planning by Lunds Energi is that, according Lunds Energi employee Lars-Göran Nilsson, new generating capacity will be added for district heating approximately 5 years.[129] An attempt was made to find an exact plan for when such an investment would occur, however, interview respondents did not have a precise answer for this. Some examples of how a utility might calculate the need for investments in new generating capacity are:

1. When the average or peak load factor of their system (kWh) reaches a certain threshold during significant enough amount of the time

2. When the use of certain more expensive fuels reaches a certain threshold or cost

In the case of Lunds Energi it has been shown that these two factors are related since fuels with higher marginal costs, such as oil and electricity, are primarily used when the load of the system reaches over a certain point.

Estimates on when Lunds Energi might invest in new generating capacity could be used to evaluate how much energy Lunds Energi customers would needs to save to avoid the cost of this investment. Next, a feasibility study could be done to see how much it would cost to save energy for Lunds Energi's customers per m^2 for different market segments or specific customers. If the cost of reducing energy among Lunds Energi customers is greater than the cost of investing in new capacity, then an energy efficiency services option would be a more profitable investment for Lunds Energi then investing in new generating capacity. This could be implemented using a performance contracting model. Unfortunately, there is inadequate data at this point to makes such estimates.

3. If Lunds Energi is able to split savings from energy efficiency with their customers as a result of using some form the ESCO concept

Whether or not Lunds Energi can obtain value from this concept for their district heating market is dependent on a number of factors. Two of these factors are reviewed here, with the remaining to be found in the next section 4.4.2 through the use of evaluation criteria for potential ESCOs.

Potential Expansion

As explained in section 5.1, a critical variable for the sale of energy efficiency services to become a success is whether or not an energy seller can profit from the sale of energy efficiency while expanding its customer base, thus achieving greater overall benefits than the costs from reductions in energy sales from its existing customers. This is especially true in the case of district heating where the energy saved by one customer may be used to expand to more customers. To illustrate this point it useful to see the scenario in which Lunds Energi is able to gain short term profit through ESCO services while their customer base remains constant. In the short term this might lead to higher profits from the new business venture. In the long run this would mean that they would be selling less energy, the primary source of their revenues. There is an additional possibility that "long hanging fruits" to be picked by ESCO activities would have diminishing returns.

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[128] Lunds Energi - http://www.lund.se/templates/Page.aspx?id=3615
[2004, August 15]
[129] Lars-Göran Nilsson. Personal Interview.

84-86% of Lund energy customers are connected to the Lund Energi grid. Ten percent of Lund energy customers use oil. The remaining approximately 4-5% use electricity and natural gas. Some of these natural gas customers are provided natural gas by Lunds Energi. Lunds Energi connects about 100 new customers per year to their grid, which equals about 2 gigawatts. Most of these customers are "small."[130] There is a remaining capacity for district heating in Lund of about 15-20 gigawatts. Therefore, with no increase in buildings and energy use, Lund Energi would have a potential for increase of about 7 to 10 years.[131] Some increase in the number of buildings in Lund is certain given that Lund is predicted to have 12,249 new residents during the next nine years, so the possibility for Lunds Energi to expand their network will likely extend beyond the above estimate (citation).

Lunds Energi has ambitions to expand outside of Lund. Out of a total of 7343 residents, 7% of Eslöv residents receive their heating from district heating, with the remaining customers receiving fuels from the following different sources: 4% biofuel, 30% oil, 53% electricity, and 1% fireplace. These numbers indicate that there is a much greater potential for Lunds Energi to expand in Eslöv than in Lund, although statistics were unavailable on the non-residential customer market. One way that has been considered to expand Lunds Energi's district heating network is to build a pipe between Eslöv and Lund and in order to reach more customers (IIIEE 2004).

Lunds Energi also has expansion plans in Lomma. Lunds Energi started building in Lomma in 1998. In 2006 they will have finished the network. They are expanding at a rate of 2 customers a week in Lomma.[132]

Therefore, Lunds Energi's possibilities for expansion are 5% of the Lund Market, 88% of the Eslöv market residential market (it is assumed that those with bio-fuel and fireplace heating will have low probability of switch to district heating) and an unknown amount of the rest of the Eslöv market, and an unknown percentage of the Lomma Market. From a long term perspective the rate and degree of Lunds Energi's expansion, which is a factor in their potential role as an ESCO, is dependent on the expansion of their business in these three market segments.

Rate Structure

When calculating energy savings one has to take into account both the reductions in kilowatt hours consumed and changes in capacity charges (section 2.3). A key question when evaluating the benefits of saving energy for customers is what amount of these energy savings will translate into financial gain? Different rate and tax structures may lead to a non-linear relation between energy saved and the resulting financial gain. Such non-linear rate structures would not be advantageous for Lunds Energi in developing an ESCO business concept as it would be easiest and most effective Lunds Energi and their customers were able to understand exactly how much money a customer saves from savings one kWh of heat or electricity. The rate structure for Lunds Energi district heating and electricity will now be described in order to attempt to analyze whether Lunds Energi bills represent this kind of linear structure.

Small houses have the price of district heating of 475 SEK per MWh from October to May.[133] The price for district heating goes down to 120 SEK per MWh from June to September. The

[130] Lars Göran-Nilsson. Personal Interview.
[131] Lars Göran-Nilsson. Personal Interview.
[132] Suzanne Andersson and Lena Slovak. Personal Interview.

fixed charge for small house customers is 1,400 SEK per year. A value added tax of 25% is multiplied by the addition of these two amounts.[134] This rate structure for small houses is shown as "Price Group 1" below. Price groups 2 through 4 represent increasing amounts of capacity for customers other than the small house qualification. In these groups capacity payment rises from 650 SEK to 575 SEK per kW as capacity increases from price group 2 through price group 5. In the equations below D stands for "power charge" or capacity. K is a constant of .55.

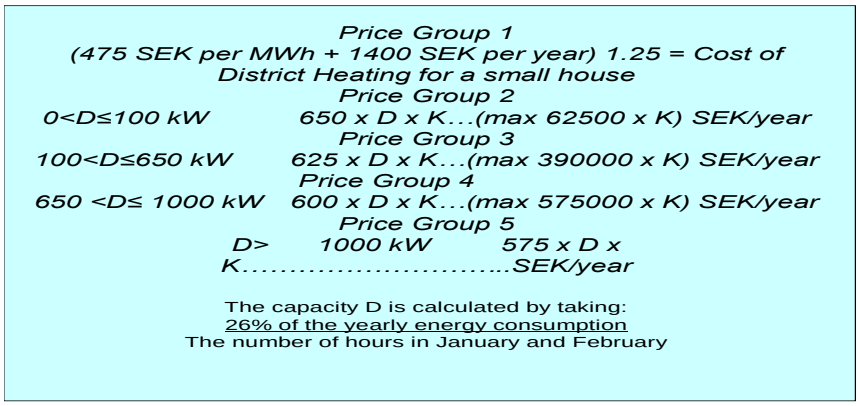

Figure 5-6: Billing Structure for Lunds Energi Heating Customers

From the price structure above one can see that from price groups 2-5 the charges given for each kWh of consumption become lower as customers move up in capacity, thus moving up in price groups.

Thus, for district heating the above rate structure indicates a linear progression where one kWh of heat energy saved leads to a corresponding financial gain either from a kWh of avoided heat cost, or from reducing the capacity K to a lower threshold.

Now the electricity rate structure for Lunds Energi will be described. This rate structure can be described by the equation: [135]

Electricity price = [electricity tax + green certificate + admin + (underbid of electricity) + (grid payment)] + value added tax

The "underbid of electricity" is written in parentheses because this only happens some of the time. This is when Lunds Energi projects a certain electricity demand for their customers, but does not buy enough electricity to meet their actual customer demand because this consumption is higher than Lund Energi's projections. Lunds Energi has been getting better at making these bids over time.[136] Numbers for the actual costs in the above equation are estimated below as given by Sigvard Strelert at Lunds Energi. The value added tax is paid by end users to Lunds Energi and then to the government. Therefore, it is not one of Lund Energi's costs.

Therefore the equation these inputs can be put into the equation above to get:

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133 Suzanne Andersson and Lena Slovak. Personal Interview.

134 Lunds Energi (2003). Prislista för Fjärrvärme Prisgrupp 1 – Småhus, Lunds Energi (Price List for District Heating Price Group 1 – Small Houses)

135 Sigvard Strelert. Personal Interview.

136 Sigvard Strelert. Personal Interview.

Electricity = (180[el tax] + 20.25[Green Certificate] + 2-3[Administration] + (200 SEK) [grid payment] + VAT = 412.25-417.25+VAT[137]

Thus, for district heating the above rate structure indicates a linear progression where one kWh of heat energy saved leads to a corresponding financial gain either from a kWh of avoided heat cost, or from reducing the capacity K to a lower threshold. A further area of inquiry would be to investigate how clearly customers actually understand the bills that they receive. Additionally, customers may be in some cases charged for energy use with a time delay from their actual use of energy. These customers, such as is the case with Region Skåne, may receive the financial benefits of saving energy, however, there will be a time delay associated with these benefits, which will serve to weaken their impact in triggering reductions in energy use.

The ability to control their customer's rate structure can be viewed as a potential asset for Lunds Energi should they undertake a performance contracting concept. The marginal costs for each unit of district heating decrease as a customer rises to each higher energy profile plateau. Lunds Energi could adjust their billing structure for their ESCO customers so that fixed costs are decreased and the customer's marginal cost for each unit of electricity is increased. This would hedge the price structure so that both the customer and Lunds Energi would have greater shared financial savings to split. Sales manager Thomas Parker felt that while this is a good idea in theory, however, he felt that in practice it would present internal difficulties within the company and external confusion among customers. Internally, this structure would be difficult for Lunds Energi since they prefer to have their cost structure reflect their actual costs. Externally, Mr. Parker felt that this move might confuse customers wondering why their prices were different from other customers.[138]

7. Value added product for both heat and electricity

Energy efficiency services may increase a energy company's competitive edge by providing a value added on their services that improves their image and adds to their overall service package serving to differentiate them from other actors. According to representatives interviewed from energy companies, however, value added services do not play a huge role in today's deregulated Swedish energy market. Sales manager Thomas Parker stated that the "very small" profit margin on electricity leads energy companies are competing on cost rather than differentiation.[139] Value added services may, however, play a greater role or potentially play a role with district heating sales.

8. Use of Performance contracting to attract customers who use oil while expanding the district heating grid

District heating generally has a 7.5 year payback time[140] for residential customers with a total cost of 60,000 SEK. It costs 20,000 SEK to connect district heating into small homes. An additional 40,000 SEK is needed for the heat exchanger. Sometimes customers buy this before they need it as Lunds Energi may be in the neighbourhood installing a network and it

[137] An underbid on the supply of electricity may lead Lunds Energi to have to buy more expensive electricity, leading to an additional cost passed on to the customer of approximately 2-3 SEK (Stig Strelert. Personal Interview).
[138] Thomas Parker. Personal Correspondence.

[139] Thomas Parker. Personal Correspondence.
[140] Lunds Energi. (2004). [Online]. Available: www.lundsenergi.se [2004, September 20]– calculation tool on website

will be cheaper for them to do this now rather than 2 years later when they need it.[141] Oil presently costs 7,000 SEK per m^3.[142]

The difference between the yearly price of district heating and an "old" oil boiler assuming an equivalent energy use of 30,000 kWh of electricity is 10,118 SEK per year. The initial fixed cost of 60,000 SEK could be paid by the customer over time through the savings from this 10,118 SEK using a performance contract. In this way the customer could avoid high initial costs and Lunds Energi could expand their district heating to customers that previously would not have taken this option due to a lack of access to capital. The pay-off times for different types of fuel supply when switching from an old boiler to the sources of energy supply listed below are given below as given by Lund energy advisor Björn Alm.[143]

Table 5: Installation costs and Pay-back times for different energy sources for Lund residential customers (using equivalent of 3,000 litres of oil per year)

Energy Source	Pay-off times in years (5% interest rate)	Installation Cost (SEK)	Yearly Cost to Customer (SEK)
Bio-fuel (latest)[144]	6	60,000	13,000
Geothermal	10.5	120,000	10,000
District Heating[145]	7.5	60,000	15,109
Heat Exchanger	9.25	90,000	12,500
New Oil Boiler	10.5	40,000	20,000
Old Oil Boiler			25,000

The switch from heating from oil to the use of Lunds Energi's district heating creates a significant reduction in the environmental impact associated with this heat production. 49% of Lunds Energi district heating production came from renewable sources in 2003.[146] Other fuel sources such as on-site geothermal and bioenergy energy production offer sources of energy production that are using 100% renewable fuels.

6. Real-time or variable pricing makes it so that, in terms of costs, the utility and the customer can be regarded as closer to one actor

If an energy retailer was already conducting ESCO services with one of their electricity customers, the customer's price structure could be switched to a more variable basis so as to capture additional savings by switching the operating of equipment to non-peak hours where possible. In some cases Lunds Energi sells electricity to customers at the Nordpool variable rates, although this is more typical of industry rather than smaller sized customers. In many cases Lunds Energi negotiates fixed electricity prices with their customers over periods of time, sometimes with different rates for summer and winter (or other variations that occur at fixed intervals of time).[147]

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[141] Suzanne Anderson & Lena Slovak. Personal Interview.
[142] Suzanne Anderson & Lena Slovak. Personal Interview.
[143] Björn Alm. Personal Interview.

[144] 13,000 SEK for new equip. & 25,000 SEK for old equipment
[145] Lunds Energi. (2004). [Online]. Available: www.lundsenergi.se [2004, September 20]– calculation tool on website
[146] This does not include the electricity used by Lunds Energi in producing energy from geothermal wells.

[147] Thomas Parker. Personal Correspondence.

7. Future Policy reasons
The proposed EU Directive on Energy End-Use Efficiency states that (Commission Proposal COM(2003)739 final):

The provision and implementation of these services and measures may well be carried out by other qualified and\or certified bodies, but the active partnership of the energy providers in this endeavour is essential to the proper functioning of the market.

It remains to be seen in the future whether or not any requirements will be placed on energy suppliers and/or retailers to provide energy efficiency services, or if these actors will be given extra incentive to do so. In the case that this does happen and that Lunds Energi begins to offer ESCO services, then Lunds Energi could gain a first mover's advantage by gaining experience in this area ahead of their competitors.

5.4.2 Lunds Energi as an ESCO? – Evaluation Criteria

It is unknown if Lunds Energi might be able to finance ESCO projects with a low interest rate, and therefore this evaluation criteria is not analyzed.

The potential ESCO perspective

- *Energy Engineers (they can also do other jobs other than performance contracting) 2. Legal Competence*

Lunds Energi sales manager Thomas Parker felt that Lunds Energi has both of these capacities.[148] No further analysis was conducted.

- *An ESCO must have the necessary technical competence*
- *Competence Project Managers 1. Ability to manage subcontractors 2. salespeople that are dedicated to only performance contracting*

Sales manager Thomas Parker felt that technical competence and the ability to acquire additional resources would not be an issue if Lunds Energi decided to venture into performance contracting. One of the questions posed by Lunds Energi sales manager Thomas Parker at the beginning of this study was "can we use our existing salespeople to provide ESCO services?" According to interviews with Swedish ESCOs an ESCO must have salespeople and project managers specifically dedicated to performance contracting. Since Lunds Energi has not been involved in energy efficiency measures since 1996, the answer to this question is that they clearly do not have such salespeople. Mr. Parker felt that there was a more important issue in their potential to be an ESCO other than their ability to use existing employees, hire new ones, and/or the quality and quantity of their technical expertise. According to Mr. Parker this critical issue is that in general management is not orientated toward demand side measures.[149]

These above statements, however, refer to the capacities necessary to implement the ESCO concept in regard to energy efficiency. In the previous section an ESCO business concept of energy supply, the use of performance contracting to finance the switch from oil to district heating was given a possible option for Lunds Energi. Under this option Lunds Energi may

[148] Thomas Parker. Personal Interview.

[149] Thomas Parker. Personal Interview.

be able to use some or all of their existing sales force since the competency involved under this option would be closer to Lund Energi's core business.

- *Tools, and skills in finance, economics, and accounting*

As a part of this research Lunds Energi was asked questions about their customer profile, for instance "do you know which of your customers are consuming a very high amount of energy relative to the rest of your customers in different building sectors?" A conclusive answer to this question was not reached from interviews. Despite this limitation, three tools that Lunds Energi might use with its existing capabilities with an ESCO business are identified below:

1. In section 2.3 it was indicated that one way to estimate potential energy savings in buildings is to compare their energy consumption per square meter with other buildings in the same sector. A comparison using this kind of reference data allows an initial assessment of the building's potential energy savings. Lunds Energi either has access to this kind of information for its customers in Lund or potentially has access to this information (possibly needing additional investments in meters). This can be regarded as a potentially very useful tool as it has the potential to investigate load profiles and build an on-going and improving knowledge of these load profiles. This content, size, and diversity of this information is simply not accessible to a typical ESCO. For example Lunds Energi could analyze energy consumption patterns in 20 apartment complexes and determine that 2 of them were using twice as much heat as the mean apartment complex of this group. Customers with potential high energy savings could be located before a phone call was ever made for the sale of a performance contract. This pre-project information and skills would serve useful during the monitoring and verification of energy savings during an ESCO project.

It is unclear whether Lunds Energi currently has the ability to access this type of information about their customers, or how hard it would be to develop such a tool. Also of importance is that Lunds Energi can have the ability to retrieve heat energy data and be able to know when it was consumed through more updated and accurate billing. This is helpful, for example, in weighting heat energy consumption with the corresponding outside temperature during a particular period of time.[150]

3. Lunds Energi's knowledge of a customer's energy consumption can be viewed not just as a information tool but also a tool for hedging their bets in their customer's energy savings for a performance contract, as explained in the previous section.

It is unknown according to this study whether Lunds Energi possesses tools, other than the ones mentioned above, in their core business that might be used in performance contracting.

- *Trust in the ESCO from potential customers is very important.*

The three real estate actors in this study were asked how they felt about the idea of Lunds Energi providing ESCO services to their organization. Respondents were generally skeptical of this idea given the incentive for Lunds Energi to supply energy, not save it, as their core business.

Robert Johansen from Region Skåne expressed this view:

[150] Mats Olsson. Personal Interview.

"If they offered it to us, in our case no, as their other business obligations in the supplier market might limit their willingness to study and offer solutions that are not congruent with other parts of their business concept."

According to Lunds Energi sales manager Thomas Parker, "our corporate identity as an energy supplier might make a move to performance contracting difficult."[151]

- *Must have a market of a critical mass of potential projects with over a certain amount of energy savings potentials as a percentage of potential customers' total energy bills*

The three real estate actors of this study and customers of Lunds Energi have estimated energy savings potentials of:

1. Region Skåne – at least 13%
2. Lundafastigheter – 5-10% given for behavioural measures by staff
3. Akademiska Hus – 27% energy savings potentials for behavioural measures by tenants

These three actors have significant energy savings potentials, however, the energy savings potentials of rest of Lund are unknown, except for some general estimations of energy savings potentials in Swedish buildings given in section 6.1

Summary – Lunds Energi

Companies that produce and sell energy directly to customers, such as Lunds Energi, have the potential to gain money from two sides of energy delivery by using the ESCO concept, on the demand-side from shared savings with their customers and on the supply side from decreased costs for expensive marginal fuels and avoided investment costs in new capacity. These demand-side factors can increase the value added of their supply of energy and combined demand and supply side factors can increase the environmental and general profile of the company. On the supply side, Lunds Energi would have to save a very large amount of energy in order to lower marginal costs of production during the winter months to their base fuels. However, there are relatively small reductions in energy consumption that can be made to achieve significant financial savings during winter months for oil and electricity production, and during summer months for oil, electricity, and natural gas production. Unfortunately, there is not enough information to calculate how much energy would need to be saved in order for them to avoid investment in new generating capacity.

There are a number of possibly useful tools that can be derived from Lunds Energi's core business as a producer and supplier of district heating and electricity retailer that could potentially be used to reduce overall project costs and provide a strategic advantage in the ESCO business. There are, however some disadvantages for an actor such as Lunds Energi to expand its business concept to include performance contracting. Most energy companies within the Swedish energy market, including Lunds Energi, do not have a great deal of experience with implementing energy efficiency as a profitable business concept. The three Lunds Energi customers in this research all expressed doubt that Lunds Energi could enter this business due to its obligations and main core competence as an energy supplier.

[151] Thomas Parker. Personal Interview.

6. Factors Affecting Performance Contracting in Sweden

This section will explain factors affecting performance contracting within Lund and Sweden from market, organizational, financial, and legal perspectives. This will provide a base to analyze policies in section seven that may help to improve factors that are causing barriers.

In order for a performance contracting market to grow and develop there must be a critical mass of potential ESCO customers with sufficient cost-effective energy savings potentials. Section 5.1 reviews conclusions from this research and from literature on estimations of energy savings potentials for existing buildings in different sectors in Sweden. A second pre-condition for a successful ESCO market, after energy savings potentials, is that there must be financing available for ESCO projects. The Swedish case of ESCO project financing is discussed in section 6.2. Some characteristics of the current ESCO market in Sweden and factors for its growth and development are discussed in section 6.3. Section 6.4 will analyze organizational factors in performance contacting in Sweden.

This section uses the sources of interviews from Swedish ESCOs, Lund real estate organizations, and the Southeast Sweden Energy Agency. Literature is used, relying heavily on the IEA DSM Task X Country Report on Sweden and Vine's (2003) International Survey of ESCO markets.[152] General international factors for ESCO markets given by literature with little perceived connection (by the author) to the Swedish case, such as high import taxes that make technology more expensive (Vine et al. 2003), are not listed.

6.1 Energy Savings Potentials

This study sees energy savings potentials from a number of perspectives:

1. The three Lund real estate actors in this study
2. Estimates from Swedish ESCOs concerning general energy savings potentials in the Swedish building market
3. Estimates for energy savings potentials in Swedish buildings given by literature

Price of Electricity

One factor that is of great importance is the price of energy. Cost-effective energy savings potentials increase as the price of energy rises and decrease as the price of energy falls. The graph below shows the Nordpool electricity prices from 1993 to the present.

[152] Vine also gives some barriers to performance contracting in Sweden. Since his methodology consisted of interviewing with one representative from thirty-four different countries find to barriers for performance contracting, along with other observations. Due to his small sample size in gaining a specific picture of Sweden, but large sample in regard to size to the general international ESCO situation, his work is cited with more emphasis on the international case.

Figure 6-0-1: Nordpool Electricity Price (MWh) 1993 to 2003
Source: Nordpool Website

The general trend in Sweden is for rising electricity prices. Taxes on polluting fuels have also been increasing. In 1994 the price of electricity was an average of 197.11 SEK per MWh. As of the summer of the summer of 2004, electricity prices ranged between 260-300 SEK per MWh.[153]

The frequent pattern of a lack of correlation between the retail cost of electricity and the prices paid by consumers leads to inefficiency in a number of ways. The market cannot allocate resources to those who want them most as these consumers do not bear the costs of their greater demand. This leads to a lack of a natural control mechanism that might prevent shocks in demand to electricity markets. The market is also not able to send signals for investments in energy efficiency during the times of the day or year that these investments are most useful in cutting peak demands (Summit Blue Consulting 2004). More variable pricing would serve to create cost-effective investment opportunities available from switching the running times of equipment to non-peak hours when possible, such as with hot water heating. ESCOs might take advantage of these new opportunities. However, despite this possible synergy, the relationship between variable pricing and ESCO markets is unclear.[154]

Price of District Heating in Lund

The price of oil, district heating are both rising as general trends as can be seen in the figure below. The price of district heating is tied to the price of oil since oil is one of the fuels used in district heating. The price of natural gas is also tied to the price of oil.

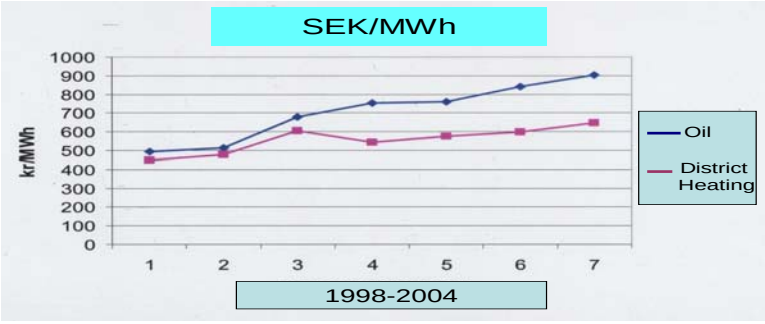

Figure 5-0-2: Price for District Heating and Oil in SEK per MWh, 1998-2004, Source: Lunds Energi

Energy Savings Potentials according to Swedish ESCOs

[153] Mats Olsson. Personal Interview.
[154] Due this lack of clarity, this factor is not be analyzed with ESCO policies in Section 7.3.

The cost-effective energy savings potentials in different sectors of the Swedish building market as perceived by representatives of Swedish ESCOs are given in Table 4. Estimates given by ESCOs are believable because their business depends that such energy savings potentials exist and that ESCOs are able to calculate them accurately. On the other hand, one possible reason why ESCOs might want to exaggerate these figures is to promote their business.

This data should be greeted with some skepticism. Unfortunately, as an issue of methodology the interviewees were asked 1. "What is the typical energy savings potentials that you come across both in your potential projects (both the ones they take and the ones they do not for whatever reason)?" and 2. "What are the typical lengths of your contracts or the equivalent what are the typical payback times for your installed measures as a whole?" Due to this uncertainty payback times are not included in the table. Thee responses were given by ESCO representatives concerning the typical payback time of their projects. These payback times for different ESCOs were a maximum of 3 years, typical payback times of between 5 to 10 years, and typical payback times of 5 years. Industrial customers were generally observed to require shorter payback times for ESCO projects.

In general, both ESCO and real estate actors were quick to add that conditions often vary when giving these numbers. For example, adding a new ventilation system in the place of a very old one might actually increase electricity use due to the increased electricity use of the new system.[155] For this reason, estimations such as "the typical energy savings potentials when a new ventilation system is put in" can be regarded as simplistic.

The typical energy savings for ESCO projects was not included as one of the questions. However, the minimum ESCO customer size of at least 1.5 million SEK from interviews with Swedish ESCOs and the energy savings potentials from table 7 below can be used to calculate the energy savings in this minimum sized project. These savings would be somewhere between 150,000 SEK (10%), 300,000 SEK (20%), and 450,000 (30%) per year.

Table 6 Estimates by ESCOs (and one auditor) for energy savings potentials in existing Swedish buildings

[155] Roland Larsson. Personal Interview.

Sector	Source	Sector	Notes
Apartments	ESCO 1	30%	
Residential	Anti-cimex	20-25%	
Residential	Anti-cimex	50-60%	With a new heat supply system included (depends on the situation)
Residential	ESCO 2	20%	
Schools, Offices, Hotels	ESCO 2	25-35%	
General - Older Buildings and Industry	ESCO 3	>20%	
General	ESCO 3	20%	
General - New Buildings [Existing]	ESCO 3	10%	
General	ESCO 3	15%	Initial Audit – measures with longer payback times can be looked at later
Commercial Buildings	ESCO 4	15-35%	"sometimes as high as 55%"
Industry	ESCO 2	40%	

Both Jonas Tegström from TAC and Frank Johansson from Siemens both observed that the public sector in Sweden has been far more effective in encouraging energy efficiency with regard to *behavior*, such as shutting off lights at night. According to Mr. Tegström, however, commercial office buildings often have larger savings potentials. In these buildings energy is often not given as high of a focus. So in the private sector energy savings potentials can often be more closely linked to behavior while the public sector often has greater potential for energy savings through capital improvements due to a relative lack of investment in buildings.

Energy Savings Potentials According to Real Estate Actors

The table below refers to estimates for energy savings potentials given by the Lund real estate actors in this research and HSB. All of the numbers below, except for those for Region Skåne, are given for a specified range of measures, which have in some cases, have already been implemented.

HSB energy manager Lennart Berndtsson was interviewed to get a perspective on the apartment building sector. The numbers for HSB are national estimates whereas the other real estate actors give local estimates for their buildings in Lund. HSB is a national Swedish real estate organization that manages tenant owned apartments. The organization has 538,000 members and is broken down into 34 regional associations with 320,000 apartments. Each of the 3,900 apartment complexes (housing cooperatives) manages its own energy investments;

therefore there are varying degrees of energy savings potentials among these different apartment complexes.[156]

Table 7: Energy Savings Potentials for Real Estate Actors Interviewed in this study

Sector	Organization	Energy Savings Potential	Payback Time	Notes
University	Akademiska Hus	20%	5 years	Upgrade ventilation system to use a variable flow
University	Akademiska Hus	27% (electricity)		Electricity savings from behavioral changes, mostly decreasing equipment running times. Estimate comes from one case study, however, the results are thought to be representative
Municipality	Lundafastigheter	5-10%		Re-adjustment of current systems by janitors
Municipality	Lundafastigheter	50%		New Ventilation Systems
Hospital	Region Skåne	13-18%	7 years	ESCO Project
Tenant-owned Apartments	HSB	15%	<5 years	Adjustment of HVAC systems

Energy Savings Potentials from Literature

An attempt was made by the author to find other studies and information in concerning the energy savings potential for existing buildings in Sweden. A few examples are now given of this potential in literature. This list is certainly no where near exhaustive.

Table 8: Swedish Energy Savings Potentials given in other studies

Sector	Source	Energy Savings Potential	Payback time	Notes
Industry	Sydkraft (*from Bringing Energy Efficiency to Liberalized Markets* (2003). Wuppertal Institute)	5-35%	1-3 years	Material waste/flow analysis given to medium to large scale customers followed by energy efficiency measures. Most of savings are due to reductions in energy use. According to Sydkaft, only 5-10% of this market is tapped today.
Government	Neij et al. *Strategies for improving energy efficiency (2001)*	Reduce the final electricity consumption by the entire government sector in Sweden of 2 TWh to 0.7 TWh		The authors state that this savings potential can be accomplished through the use of "energy efficient products"
Industry	Trygg et al.	50%		Eleven industrial plants in Oskarshamn, Sweden

Michael Bergmasth and Mats Strid (2004) estimate that the costs for "making energy use more efficient" are 3.3 SEK/kWh, making these costs higher than the costs of producing energy at 0.3-0.7 SEK/kWh (Bergmasth & Strid 2004). The main reason for these high costs for energy

[156] Lennart Berndtsson. Telephone Interview.

efficiency, according to Bergmasth and Strid, is the high transaction costs involved. Despite this, however, Strid and Bergmasth find that 92% of energy company customers have potential "profitable, but unrealized energy efficiency projects" (Bergmasth & Strid 2004).

Summary

Cost-effective energy savings potentials are generally perceived to occur across all Swedish sectors according to Swedish ESCOs interviewed in this research. This perception corresponds to more general EU data and other research within Sweden.

6.2 Organizational Factors

This section provides some background on factors inhibiting greater performance contracting (not to be confused with factors within organizations toward achieving greater energy efficiency) from occurring within organizations, as given by literature. The perspectives of potential ESCO customers and existing ESCOs are analyzed here. Organizational factors within potential ESCOs are addressed in the next section on market factors under the subject of "barriers to market entry."

Potential ESCO Customers – Organizational Factors

The IEA brought together various actors involved with or interested in being involved with performance contracting to discuss performance contracting. This report, the International Energy Agency Demand Side Management Task X Country report on Sweden, outlines some barriers and opportunities for performance contracting in Sweden.[157] For brevity, this report will be called the IEA DSM Task X report.

Factor given by IEA DSM Task X report:

Organizations are unfamiliar with performance contracting
One of the barriers listed by the IEA DSM Task X report is that "[potential] *customers are unfamiliar with performance contracting",* a barrier to performance contracting that was also given in interviews with Lund real estate organizations and Swedish ESCOs (IEA 2001). This can also be considered a market barrier, however, it is also included here as an organizational barrier. Recall that in section 3, power structures within organizations are important for implementing energy efficiency improvements, therefore it matters who is familiar with performance contracting within organizations and supports it if an organization is going to buy into the idea.

Factors given from interviews:

Perceptions Concerning ESCOs
1. One negative perception that may exist is that an ESCO might have an interest in a building that is overly weighted toward short term paybacks over the long term functioning of the building.[158]
2. Some potential customers may perceive ESCOs as a threat to their core business. For example, in the Swedish real estate market the owner and the operator is often the same actor.

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[157] A more recent IEA report on performance contracting has been published or will be published soon at the time of this writing, however, there was not a chance to incorporate this report into this analysis.

[158] Lennart Berndtsson. Telephone Interview.

This can inhibit performance contracting procurement in that this owner/operator actor may be unwilling to outsource its core competence, which is with the operation (including energy management) of its building.[159]
3. Some potential ESCO customers may not want to outsource in general.[160]

Cost and Focus Priorities
Swedish Industries have tended to focus on core production costs, at the expense of substantial cost cuts for energy and operation and maintenance investments that can be realized. The relatively high internal rate on investment and demands for short pay-off has been unfavourable for energy efficiency investments.[161]

Difficulty in arranging long-term planning in short term political cycles
Short political cycles and a long process to decide among bidders can serve as obstacles for the public tendering of contracts.[162]

ESCOs – Organizational Factors

Financing
For individual ESCOs with a functioning business model, factors that may push ESCOs to finance projects rather than their customers may not be considered barriers for the growth of their business. None of the four Swedish ESCOs interviewed listed this issue gave financing as a barrier for greater procurement of performance contracting to occur Sweden. However, according to Manuel Swärd at the Southeast Sweden Energy Agency:

To obtain a loan for building refurbishment and simultaneous energy efficiency is normally not a problem. However, the creditors are still relatively reluctant towards [providing investment] for energy performance contracts.

All four ESCOs that were interviewed for this study generally finance their own projects. Some of these ESCOs, however, sometimes have customers finance projects if the customer wants this arrangement. The table below shows the four ESCOs interviewed in this study and some of their characteristics, including financing. Blanks reflect information gaps due to a lack of time during interviews.

Table 9: Project Investment, Core Business, Customers, and Number of Projects
ESCOs interviewed in this study

ESCO	Who provides project investment?	Core Business (other than their performance contracting division)	# of current projects	Customers
Skånska	Customer	Facilities Management	10-15	All Industry
Siemens Building Tech.	ESCO – leasing	Building Automation	30	Mixed – Mostly new customers
YIT	ESCO	Facilities Management	50	60% industry, 20% commercial, 20% public - mostly existing customers

[159] Jönas Tegstrom. Telephone Interview.
[160] Jönas Tegstrom. Telephone Interview.
[161] Manuel Swärd. Personal Interview.
[162] Rowan Wright. Personal Interview.

TAC	ESCO			Mixed – New Customers

ESCOs may come up with creative solutions and/or agreements with banks in order to solve how they provide project investment. In order to cut the cost of capital and to create and smoother and more effective transactions, a structure of bulk financing can be used. The concept is based on a public or private creditor creating a financial portfolio for their ESCO companies and customers so as to allow these actors to withdraw capital from this portfolio to implement projects under predetermined and agreed conditions.[163]

Therefore, the fact that most Swedish ESCOs provide project invest for the majority of their projects may not be a significant factor of success of their individual businesses, however, this factor becomes more important when regarding the ESCO market as a whole.

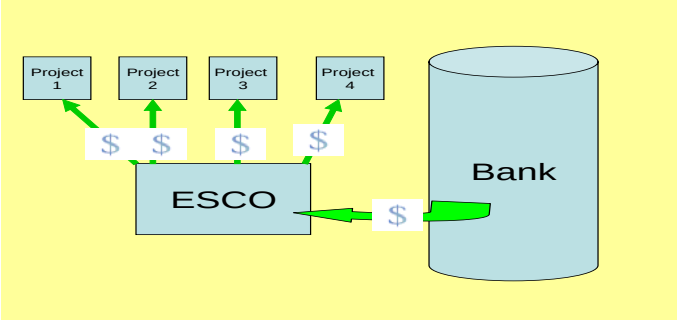

Figure 6-0-3: Bulk Financing of ESCO Projects:
Source: Manuel Swärd, Southeast Sweden Energy Agency

6.3 Market Factors

The existence of energy savings potentials, adequate financing by ESCOs and/or financial institutions and of suitable potential ESCO customers does not guarantee growth in the total number of ESCO pojects. For this to occur there must be a functioning ESCO market. One definition of a market is an area of economic activity in which buyers and sellers come together and the forces of supply and demand affect prices.[164] Therefore, it is necessary to analyze whether there are an adequate amount of buyers, an adequate amount of suppliers, and what difficulties these buyers and suppliers may have in forming contracts that are mutually beneficial. A fundamental driver of both supply and demand in any market is price, in the ESCO market reflected to a large degree by the energy price and the corresponding (under present available technology) energy savings potentials.

Market Barriers from the IEA DSM Task X Report:

Transaction Costs
As stated in Section 3, transaction costs may be reduced by organizational structures, however, they also may represent a general market factor for investments in energy efficiency. The IEA DSM Task X report on Sweden lists transactions costs as a barrier "in selling energy efficiency and evaluating a property's energy status."

Quality of services and Lack of knowledge

[163] Manuel Swärd. Personal Interview.
[164] Merriam-Webster Online. (2004). [Online]. Available: http://www.m-w.com/ [2004, November 12]

The IEA DSM Task X report states that the "uneven quality of energy consultants can make potential customers cautious" and as already stated, this report gives a lack of knowledge concerning performance contracting as a barrier. These barriers can fall within the more general market factors of risk and imperfect information, which are elaborated upon using literature below.

Factors from Literature:

Imperfect Information
According to Senge (1990), a fundamental cause of barriers in many systems is the inability of participants to perceive and react to causal relationships that are separated by time and space (Senge 1990, p. 89). Time delays between consumption and the payment for energy use and the inability of consumers to understand energy complicated energy bills are two sources of such disconnects in causal relationships found in the system of energy supply. Andreas Biermann from the UK Energy Savings Trust associates this disconnection with a lack of demand for ESCO suppliers (Biermann 2001):

The basic problem behind the absence of demand-pull in the [ESCO] market is a lack of signals from which consumers could understand how their use of energy is connected with their bill, and how they can affect this.

According to Grove & Eto (1996) imperfect information within energy efficiency markets can be divided into three areas the amount of information lack of information, the cost of information, and the accuracy of information.

Perception of Risk
According to Vine risk in ESCO markets includes both technical and business risk, the conservative behavior of customers and financial institutions, and risk that core production processes may be affected (Vine 2003). In the international case, one common barrier is that customers have a lack of confidence in the services and solutions provided by ESCOs (Vine 2003). In Vine's interview with a "a key ESCO contact" in Sweden for his international survey of ESCOs, this contact listed a "lack of trust in ESCO solutions and bad will from earlier ESCO failures" as the second most significant barrier to performance contracting in Sweden after a lack of information and understanding of performance contracting.[165] According to Ramesohl et al. (2001), the mutual trust between ESCOs, their clients, and banking institutions is a critical factor for the development of an ESCO market. The trust, perceptions of credibility, and confidence felt between ESCOs, their customers, potential customers, and financial institutions all contribute to greater or less perceived risk involved in undertaking projects, therefore these interlinked factors are all grouped here under the factor of risk.

Swedish ESCO Market – Supply and Demand

Swedish ESCO Market - Supply

The IEA DSM Task X Report states that (IEA 2001):

The backgrounds of ESCOs in Sweden vary widely. They may produce energy, manufacture equipment, work as facility managers, or provide consultancy services. Some of them have their own financing companies.

[165] The other three barriers given, listed in order of significance are "public procurement rules, lack of accepted contract conditions, and time consuming processes to agree on contract."

A lack of agreed upon definition contributes to a difficulty to assess the Swedish ESCO market for conditions such as its market size and growth. The Swedish ESCO industry grew during the 1990s (IEA 2001). Interviewees with knowledge of the ESCO market in Sweden were asked who were the operating ESCOs in Sweden. Each subsequent interviewee was given the most updated list of ESCOs collected from previews interviews, leading to the list of ESCO suppliers in Sweden below, although this list may be incomprehensive.

- Siemens
- TAC
- Skånska
- Vättenfall, Sydkraft and other energy companies
- Johnson Controls
- Honeywell
- Several of the energy consultant firms moving into developer roles could come into the ESCO business. The number and identity of these companies has not been quantified yet.[166]
- Serco
- YIT
- Rega Energi Planing
- Bravida
- Dalkia

One way to increase the supply of ESCO services is to develop this business concept to have a greater scope. Lunds Energi was analyzed in the previous section as a potential ESCO customer. Increasing the scope of this market to include energy suppliers would increase the number of suppliers involved and possibly cause customers to be reached that might not have otherwise been reached (e.g. customers switching energy supply or existing customers of these energy suppliers). Another way to increase the supply and scope of ESCO services is to develop the market to include smaller customers, which will be analyzed in the next subsection 5.3.1.

Swedish ESCO Market - Demand

The IEA DSM Task X report (2001) gives two of the factors listed above as barriers inhibiting the market demand for ESCO procurement in Sweden: 1. the varying quality of services provided and 2. transaction costs involved in ESCO contracts.

This first barrier given by the IEA DSM Task X report was neither confirmed nor refuted in interviews during this research. Related to the issue of a lack of knowledge by potential customers of performance contracting is whether the ESCO is first contacting the customer or the ESCO is first contacting the customer. At least one representative from all three Lund real estate case studies had heard of performance contracting. None of these people, however, had contacted an ESCO (Region Skåne was first contacted by an ESCO) for an estimate on what services they might be able to provide. This observation goes along with the observation of the IEA DSM Task X report that:

One sign that the market is undeveloped is that up until now, it has always been the ESCO that has taken the initiative in contracting. There is still an enormous unmet demand for saving energy.

Porter's Five Forces

[166] Manuel Swärd. Personal Interview.

Four forces that Michael Porter (Payne et al. 1996) uses to analyze the intensity of industrial rivalry within an industry are the barriers to entry in the market by new entrants and substitutes, and the bargaining power of buyers and suppliers (Payne et. al 1996). Barriers to entry for new market entrants and subsitutes may be considered beneficial since they protect existing businesses and make markets less volatile. However, in the case that one is discussing the potential for the growth of a market, then barriers to entry can be regarded as inhibiting forces. Of course, the possibility remains that growth of the number of ESCO projects may be better achieved with existing businesses rather an increase of new market entrants. Two additional important forces in markets are the bargaining power that buyers and suppliers have in influencing price in the industry. If bargaining power is too strong one side, then self-interest will likely cause this side to exploit the other side (Golove et. al 1996) and industrial rivalry will increase in this industry. From a market perspective, the intensity of industrial rivalry lowers prices within an industry, and making it difficult for firms in that industry to stay in business.

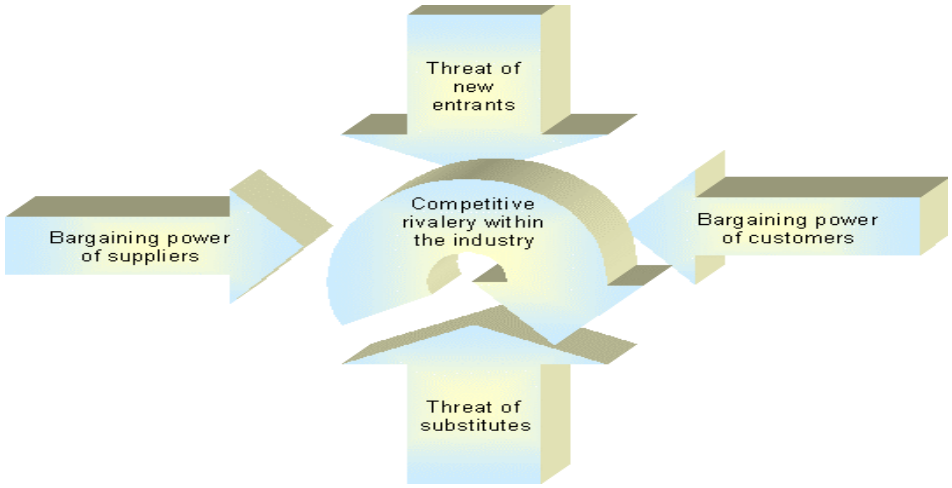

Figure 6-3: Porter's Five Forces
Source: Themanager.org (2004)

Barriers to market entry by Substitutes

Two potential substitutes for performance contracting are total energy solutions and for customers to implement energy efficiency measures on their own. Certain customers can most likely implement all of the services provided by ESCOs. It is likely, however, that a large amount of potential customers could not find use for an ESCO's services assuming they are above a certain size and have a minimum amount of energy savings potentials.

Total energy solutions are when an energy supplier charges for the service of comfort or heat rather than the product of kWh. This concept has been used by the Swedish energy company Vattenfall to a limited degree, however, it is not a significant part of their business.[167]

Barriers to market entry by New Competitors

The ESCO market in Sweden and elsewhere has significant barriers to entry due to demands that performance contracting sets for a potential ESCO in areas such as staff, financial ability,

[167] Thomas Davey. Personal Interview.

and the needed trust for this potential ESCO to have or gain from their potential customers.. This is not a small set of requirements for a new business. Businesses with existing core areas that expand to include performance contracting, such as facility managers, may have the easiest transition into this business. There are little or no ESCOs in Sweden that have performance contracting as their primary business (although the performance contracting branch of the company may be a stand-alone and profitable section).

One potential organizational barrier for a potential ESCO to successfully enter and engage in this business is in their thinking. The ESCO business requires a fundamentally different way of thinking about energy and business than many people and/or organizations are used to. It requires the selling of the service of energy efficiency rather than products such as the installation of a new HVAC system or the sale of kWh. According to Frank Johansson at Siemens:

Our business is about making our customer and our customer's customer think the way we do about energy.

A possible major barrier for new market entrants to supply performance contracting is the market conditions that most ESCO projects in Sweden do not rely on customer financing (guaranteed savings), an issue that will be discussed further in the Section 6.4.

Bargaining Power of Buyers and Suppliers

According to Porter's five forces framework, a company can have bargaining power over its buyers if it can provide "distinctive benefits" such as quality, type of service, etc (Payne et al. 1996). An ESCO's value chain is complex (Figure 2-1) and its staff requirements are diverse. Additionally, the Swedish ESCOs listed at the beginning of this section come from a variety of core businesses (equipment manufacturers, building automation, facility management, etc.) and possess a variety of ESCO business models, thus their different services probably do not risk being uniform. In Porter's framework, the bargaining power of suppliers can be indicated by number of suppliers relative to the number of organizations within an industry. If the industry large and there is a large number of suppliers, then it will have a great deal of bargaining power over its suppliers, and visa versa (Payne et. al 1996). The Swedish ESCOs TAC, Siemens, and YIT all reported to have a variety of suppliers. The relative size of equipment manufacturers is most likely larger than that of the ESCO market in Sweden, however, this issue would have to be further examined to provide an analysis.

6.3.2 ESCOs and Smaller Customers – Market Boundary

Recall that in a global context, customers under amount of energy consumption are usually left out of the ESCO market (Section 2.6.1). The reason for this is that the transaction costs with smaller customers are too high and the energy savings are too low to justify performance contracting (Witte et. al 2001). The development of the ESCO business concept to include smaller customers would widen its influence in reducing environmental impacts and improving economic development to include actors that are important from a social perspective, smaller actors such as small and medium sized enterprises and the residential sector. This development would also cause a growth in the number of ESCO projects given the expanded scope of the performance contracting customer base.

In the Swedish case, four ESCO interviewed in this research study required that customers should have at least 100,000 square meters or have a minimum yearly energy savings potential of 100,000 SEK. There is some reason to believe that such a business concept could be

developed for an ESCO to focus on smaller customers. Even with its minimum requirement TAC normally starts with smaller areas, such as increments of 20,000 square meters. The use of a minimum requirement is not based on the fact that projects under this amount would not be profitable. According to Jonas Tegström at TAC using the ESCO concept for smaller customers would work given "simpler services in order to get leverage on the investment.[168]" An example of simpler services in the energy efficiency market is suppliers of heating ventilation and air conditioning systems or other small actors that supply systems on a much smaller and local level, although there are not any known examples where these services are provided with energy savings guarantee attached.

An explorative approach was taken to find a viable business concept where an ESCO could capture the smaller customer market by contacting researchers and practitioners in the areas of energy efficiency and ESCOs.[169] Two case studies were identified, along with an energy auditor in the Swedish case.

Ant-cimex (Sweden)

Anti-cimex is a company that, as one of its business activities, conducts inspections of houses when they change ownership. Anti-cimex has expanded this concept to include energy audits that are done in cooperation with one of the largest real estate organizations in Sweden. The motive for both organizations to get into this business is to prepare for the upcoming EU Directive on Energy Performance of Buildings. Anti-cimex charges 3,500 SEK (393 €) for these energy audits. Anti-cimex has already conducted 5,000 of these kinds of energy audits. Anti-cimex does about 1.5 per day inspections of small houses per day, which includes the sight visit and analysis.[170] These inspections include looking at heating systems, humidity, temperature, windows, etc. They take this data back their energy center where they simulate the energy savings potential of different measures using software. A guarantee is given for indoor climate but not for energy savings.[171] Anti-cimex represents the preliminary analysis stage of an ESCO project as shown in Figure 2-2.

E-Ster (Belgium)

E-Ster is a two employee start-up company in Belgium that began in March 2004; 5 months after the Belgium market underwent liberalization. After three months of business they had gained 30 residential customers and one accountant office customer. According to E-Ster co-operator Wim de Groote, a great deal of this business was initiated through "word of mouth."

The business model of this company is that first an audit is conducted of a customer's home or building, given at a cost of 121 euros including tax, plus transportation costs. Next, the company[172] installs measures that "spans a whole range of measures" such as appliances, roof insulation, replacing old refrigerators and freezers, assists customers with replacing lights, replaced pumps from central heating, and adjustments to existing equipment so that it turns off when not being used.[173] The customer pays for these items "just as an ordinary sales

[168] Jonas Tegström. Telephone Interview.

[169] The following people were contracted with this inquiry by phone, in person, or by e-mail: Edward Vine (US Berkeley National Laboratory), Wolfgang Irrek, Lars Nilsson (Lund University, LTH), Paolo Bertoldi, Björn Alm, Fredrick Lagergren (Royal Institute for Technology, Stockholm), Silvia Rezessy (Central European University), Thomas Davey, and Stefan Gärtz; however this issue was addressed with most interviewees.

[170] Mats Samulsson. Telephone Interview.

[171] Mats Samulsson. Telephone Interview.

[172] Wim de Groote. E-mail Correspondence.

[173] Wim de Groote. E-mail Correspondence.

contract for goods." The goods are bought in bulk by the company thus making them cheaper. The discount is shared between the buyer and E-Ster. The final step in the contract is that customers are offered bi-monthly electricity meter readings, and for E-Ster to give feedback on these readings, for which the customer is charged 25 euros per year. . This is, according to Wim de Groote, a successful and affordable way for them to conduct monitoring and verification of their customers' energy savings.[174]

There are, however, no energy savings guarantees. Predictions for energy savings are often as high as 50%, but this concept is too new for E-Ster to give any average or general savings potentials for their customers. According to Wim de Groote, E-Ster does not currently have any competitors in their market segment, however, they are "experiencing all of the problems of a starting company."

Energieberatung (Germany)

A second example of the ESCO business concept being used with smaller customers is the company Energieberatung Philippe Redlich. This company was founded in 1998 (originally called SparWatt) by Dr. W. Neumann. The company was run by Dr. W. Neumann and Philippe Redlich until 2002, when Mr. Redlich became the sole operator. Energieberatung does energy audits of houses, SMEs, and municipalities. The audits typically consist of an assessment of electricity and water savings potential, explaining the results to the customer, and recommending actions to be taken.[175] The decision was made to focus on electricity and water audits, because, according to Mr. Redlich, there are no other providers of these services in Germany for households. Separately, Energieberatung offers audits for heating and insulation, either a "short form" for 100 € or "expert opinion" of 700 €. Energieberatung offers monitoring and verification services if they are requested by the customer. There has been little interest in monitoring and verification among their customers in the residential sector.

In the residential case, Energieberatung checks lights, refrigerators and freezers, television, satellite receiver, video, and heating pumps. Payback times are "often less than 3 years" but larger investments like heat pumps take longer. On average Energieberatung saves their residential customers 800-1000 kWh per year, 20 cubic meters of water per year (equal to 200-300 €), and a reduction in CO_2 of one tonne per year.[176] One of the bases of this business concept is that some products that Energieberatung installs "are not easily available for end customers." Energieberatung provides this link. Less than 100 customers have used this service.

Small and medium sized enterprises and municipalities need more time and cost more, "nearly in proportion to the cost of electricity." These projects usually cost the customer 10-13% of their yearly electricity bill. Further investment often yields energy savings of 8-20% of the electricity bill.[177] During his initial time in this business, Mr. Redlich spent at least 30%, sometimes more, of his working time gaining customers and negotiating deals. Now, more and more customers come to him after hearing good references. Mr. Redlich does not currently actively seek out residential customers, although these customers are a part of his business. Although there is no minimum customer size, a "good" size is one that is over 1500 m^2 or with a consumption of greater than 50,000 kWh of electricity per year.

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[174] Wim de Groote. E-mail Correspondence

[175] Sparwatt. [Online]. Available: http://www.sparwatt.de/html/english-page.html [2004, July 20]
[176] Sparwatt. [Online]. Available: http://www.sparwatt.de/html/english-page.html [2004, July 20]
[177] Philippe Redlich. E-mail Correspondence.

While having some success in the past and winning an award from the Wuppertal Institute, Energieberatung is not currently very active. According to Philippe Redlich, one difficulty with conducting business in his market is that one has to recommend specialized products that sometimes have no competition.[178] As indicated with Porter's five forces model, in any business market, when suppliers are few, then they have a great deal of bargaining power, preventing greater industrial rivalry and further development of the market. According to Mr. Redlich, a needed tool for his business would be better software for conducting electricity audits (adequate software is available for evaluating heat and insulation measures).[179]

According to Dr. W. Neumann, former Energieberatung employee, the most significant barrier has been that "it is a rather huge work for advertisement to convince local people to use this service."[180] Dr. W. Neumann stated that in some cities this concept has been successful, however, in these cases local governments have often provided marketing and absorbed 50% of the costs.[181]

Analysis

The existence of Anti-cimex as a market actor presents the opportunity for another market actor to take over after Anti-cimex has conducted an audit. At this point, some of the project costs will have been lowered for this potential second actor after Anti-cimex has identified opportunities for customers.

E-Ster and Spar Watt both represent a business model of an energy auditor that also provides a contract service for goods without an energy savings guarantee on these goods. The fact that a great deal of E-Ster's business, at least in the present initial stages comes from "word of mouth" illustrates one possible way of lowering the relatively high transactions costs attached to smaller ESCO-like projects. The energy savings predictions and offer that they read customer's meters puts E-Ster closer to a full ESCO value chain, however, they stop short by not offering a guarantee on these energy savings. Energieberatung has had difficulty in marketing its business concept without using government assistance.

6.4 Financial and Legal Factors

Financial Factors

Establishing Collateral

A possible major barrier for market entry for new ESCO actors is the fact that the majority of ESCOs in Sweden provide project investment for their projects (shared savings). For the growth of ESCO markets in general, there are some advantages of having customers take out loans for ESCO projects (guaranteed savings). It may be easier for new players enter into the ESCO business if they can have customers take out loans for their projects due to lower interest rates and lower risk, which may lead to lower overall lower project costs (World Bank 1999). According to the World Bank (1999):

[178] Philippe Redlich. E-mail Correspondence.

[179] Philippe Redlich. E-mail Correspondence.

[180] Dr. W. Neumann. E-mail Correspondence.

[181] Dr. W. Neumann. E-mail Correspondence.

The more projects of this kind that an ESCO finances; the more its balance sheet comes to resemble a bank's, and the more its debt-to-equity ratio[182] deteriorates.

An organization with a great deal of existing financial capacity may be able to handle the risk associated with shared savings contracts, however, this may keep out new market entrants.

One reason that there is not a greater practice of guaranteed savings contracts in Sweden may be a relative lack of confidence and experience with the ESCO business concept in Sweden. Another factor may be the Swedish "Jordabalken" law or "Code of Land Law." The IEA DSM Task X report (2001) states as one of its recommendations that:

The problem with financial security in the code of land laws ought to be remedied

This law inhibits companies from taking back items that have been installed in a building that can be considered "part of the building" (IEA 2001). Four Swedish ESCOs were asked what barriers were opposing greater procurement of performance contracting in Sweden. The Jordabalken law was not given as a barrier. However, this law is cited in the IEA DSM Task X report as a barrier. This report states that "some ESCOs say that 'the banks[183] are very interested, but establishing collateral due to the code of land laws is a problem'" (IEA 2001). Manuel Swärd from the Southeast Sweden Agency also felt that this law is a significant factor in limiting Swedish ESCOs to provide their financing solutions. According to Mr. Swärd, there are solutions to handle this, but to finance something without any security is always an issue. Mr. Swärd observed that during time working for TAC from 2001-2003, that the TAC branch in the US could operate their business in a more contractually and financially mature market, and that they and their customers could much more easily finance performance contracting projects through banks and other creditors.

It is unclear from the 2001 IEA DSM Task X report what exactly is meant by the recommendation of this report to "change" the Jordabalken law as no clear recommendation is given on how to change this law or what to replace it with, along with any concerns that might arise from changing it. Additionally, as indicated in Section 2.1, the salvage and reuse value from an ESCO's installed measures is often not of great financial interest, therefore it is unclear why and if changing this law would lead to significant changes in the Swedish ESCO market. An interesting area of further research would be to examine how legal structures and practices in other countries deal with this issue. Even in the case where ESCOs can legally repossess equipment if a customer defaults on their payments, this is still practically difficult and perhaps also not cost-effective to remove installed equipment from a customer's buildings.

Legal Factors

Ease of Public Procurement

Vine (2003) writes that in the international case one barrier for ESCOs in gaining contracts with public organizations is that there are often "no guidelines to support the decision making process" which is related to another barrier listed by Vine et al. of legal difficulties with public procurement. This is also the case in Sweden. When asked about the potential for the use of performance contracting in Sweden, Rowan Wright responded that one barrier for the procurement of performance contracting at Lundafastigheter would be the lengthy process

[182] This is the ratio between the long-term funds provided by creditors and funds provided by shareholders, with a high ratio indicating a high risk.

[183] Manuel Swärd. Personal Interview.

and time involved in outsourcing any activity in the government sector in Sweden, which might inhibit development these projects.[184] Employees at Region Skåne were initially unsure how to construct a bid for public services for performance contracting. In this case, the lack of certainty on how to go about this process changed as a plan was developed. Public procurement of performance contracting requires a new solution be invented each time since there is no standardization of public procurement laws. According to Manuel Swärd from the Southeast Sweden Energy Agency, one difficulty with public procurement of performance contracting in Sweden is that the general accounting rules for public organizations, especially for energy performance contracting and third party financing has been unclear in terms of what's a loan, leasing and on vs. off balance, etc.[185] Some actors may not attempt to procure an ESCO's services due to these perceived difficulty.

[184] Rowan Wright. Personal Interview.

[185] Manuel Swärd. Personal Interview.

7. Policies for Performance Contracting in Sweden

Why is it interesting to use public policy to promote performance contracting?

Many Swedish government activities used to promote energy efficiency have been effective while they are in place. However, in many cases, once projects end then there is failure for the implemented improvements to lead to continual improvement or "take a life of their own."[186] Focusing on the private market tool of ESCOs is hoped to provide these wanted on-going improvements.[187]

To address why the promotion of ESCO markets by government policy is interesting in a more general context, it may be helpful to group environmental policy strategies into two categories. One approach is to promote policies such as CO_2 taxes and environmental permitting. Such policies can all be regarded as generally attempting to collectively lessen the environmental impact of businesses and other actors, and possibly to change these business concepts to more sustainable ones.

Policies that promote energy service companies can be placed in a second category. These policies can be used to accomplish a different goal than lessening specific environmental impacts. These policies can be used to promote a business models that have some inherent positive externalities. Certainly, there may be considerable environmental impacts associated with an ESCO's business model if it, for example, does not properly dispose of waste from retrofits. The simple fact remains, however, that if an ESCO makes more money, then it is enabling new customers to save energy.

Promoting or incubating existing or potential "sustainable" business models should certainly not replace more top down measures such as CO_2 taxes. These different groups of policies complement one another. The fact remains, however, that certain businesses models (e.g. landmines, nuclear power) will probably never develop into environmentally and socially sustainable business models. Therefore, given that some existing business models (and those yet to be created) can be regarded as having some positive environmental or social externalities, these business models should be promoted using public policy. Individually they may represent very small scopes, however, collectively they represent an important step in the journey of sustainability. Author John Elkington (2001) calls the potential form of such business models "honeybees" for their ability to regenerate natural capital sustainably, "cross-pollinate" positive effects to other actors, and for their disproportionate ability to conduct "heavy lifting" on the journey of sustainability by influencing the behavior of whole economies.[188] In many cases policies already exist that promote businesses with positive externalities such ESCOs, organic food, renewable energy, businesses that create environmentally and socially desirable redesign and planning of communities, "green" buildings, or other businesses with positive externalities and relatively more sustainable business models. Another step would be to frame these activities within the larger context of promoting these business models, not just individually, but also as a group.

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[186] Manuel Swärd. Personal Interview.

[187] Manuel Swärd. Personal Interview.

A possible drawback with the above approach is that it can be seen as unfair for the government to "pick the winners" among businesses. Even if governments tried to implement this strategy the dynamic and unpredictable nature of business might stifle these efforts. With this taken into account it should also be noted that many businesses with very negative environmental and social externalities are currently greatly subsided by governments.

7.1 Policies for Increased Energy Efficiency in Sweden and the EU

Structure of this Section

The next three sub-sections will contain policies for increasing energy efficiency in Sweden and the EU (7.1), existing and potential policies for further growth and development of ESCO markets in Lund and Sweden (7.2), and policy recommendations for promoting growth and development of the ESCO market in Lund and Sweden (7.3). Existing and potential new policies for Sweden (including EU policies) are incorporated into this analysis to further evaluate existing policies and provide a reference point for potential new policies. An interesting area of further research would be to further investigate potential policy in a municipal and/or regional context to promote ESCO markets.

Methodology for Choosing Policies

There are a variety of proposed and existing policies in the EU and Sweden that are fairly complex, require a great deal of coordination between different actors in Sweden and/or the EU, and require continual administration and updates, such as the upcoming EU Directive on Energy Performance of Buildings, tradable white certificates, environmental permitting (e.g. Swedish permits and/or the IPPC), product policies. In practice, many managers in public and private organizations have difficulty in keeping up with these instruments. Due to these conditions, complex ESCO policies that are viewed to introduce new *policy systems*, as opposed to those that aid or develop the existing policy structure, are not analyzed in this structure. Therefore, although this distinction is admittedly vague, policies such as white certificates, emissions trading and competitive bidding are excluded from this analysis. However, the possible synergies that may be accomplished with the policies analyzed and new tradable certificates schemes are discussed in section 7.3.

Swedish and EU Policies for Greater Energy Efficiency

This section will review policies and instruments that are being used in Sweden to promote energy efficiency and some relevant EU directives. This is list is not comprehensive but covers the policy measures that the author sees as most useful for developing performance contracting in Sweden.

1. *Energy taxes* are used in Sweden. These taxes are used to include some of the costs that are externalized in the price of energy. These taxes only affect the energy price; therefore they can be said to help alleviate price barriers for energy efficiency improvements (Neij L. & Öfverholm 2001).

2. *Product efficiency standards* are used in Sweden to set a floor on energy efficiency in different markets. The standards are updated every few years in order to force the worst products out of the market and to cause a continual increase in efficiency. A similar energy efficiency floor and gradual improvement in standards have been set in Swedish building codes since the 1970s (Neij L. & Öfverholm 2001).

3. *The EU Directive 2002/91/EC of 16 December 2002 on the energy performance of buildings* can be seen as a possible market opportunity for ESCOs in Europe and Sweden. This directive requires that member states develop methodologies to calculate the energy performance of new buildings. Buildings are then rated with certificates according to this methodology. Minimum standards are to be adopted for the energy performance of new buildings and for large buildings (over 1,000 square meters) undergoing major renovation. Other than this size requirement, the decision to incorporate additional building sizes under this directive will be taken by individual member states. Buildings that are sold, constructed, and rented out will make energy performance certificates available to owners and prospective buyers.[189] The Swedish government has not yet issued these minimum standards nor decided exactly how this directive will be implemented in Sweden. Member states have until 4 January 2006 to transpose this directive into national legislation.[190] This short time frame has some observers in the EU concerned that compliance may be difficult to achieve" (ACEEE 2004). In Skåne, the region of Sweden where Lund is located, the Skåne Energy Agency (Energikontoret Skåne in Swedish) is undertaking a pilot project with the City of Malmö and HSB to "test and evaluate" existing methods of energy certification of buildings from Denmark and the Netherlands for their financial results, public acceptance, and other aspects of their implementation.[191]

The American Council for an Energy Efficient Economy report "Towards Energy Efficient Buildings in Europe" (2004) states that the certification of energy performance in buildings should not be seen "as an end in itself but as a means to an end" (ACEEE 2004). This report recommends that member states accompany this directive with effective information campaigns to explain to the public the meaning of these certifications.

This directive provides a number of opportunities for the increased marketing and marketing value of energy efficiency. In public buildings over 1,000 m^2 an energy certificate will have to be placed "in a prominent place clearly visible to the public." These certificates can be used as a marketing tool to promote energy efficiency and/or to provide reward or punish public organizations for their energy performance through the increased transparency provided by these energy performance certificates.[192]

In interviews, some Swedish ESCOs cited this upcoming EU Directive as an opportunity for their businesses. The Directive mandates that:

The certificate shall be accompanied by recommendations for the cost-effective improvement of the energy performance.

ESCOs may be able to take the role of the building certifier needed for the implementation of this directive. Once the ESCO has done this they will possess some knowledge of the customer's building, and they can use this position to give the customer an offer for a performance contract, thus extending their service.

7.2 Potential & Existing Policies for Growth and Development of the ESCO market in Sweden

[189] EU Directive 2002/91/EC on the energy performance of buildings
[190] EU Directive 2002/91/EC on the energy performance of buildings
[191] Energikontoret Skåne. Available: http://www.ek-skane.se/index.php?id=62 [2004, September 1]
[192] EU Directive 2002/91/EC on the energy performance of buildings

There are now two Swedish government initiatives that are aimed to directly support performance contracting. These initiatives will be reviewed briefly, followed by a review of Paolo Bertoldi of the EU Joint Research Commission's proposed six step strategy to "foster the Development of the ESCO Industry in Europe" (2004).

Existing Policies to Promote ESCO Markets in Sweden

Four Swedish ESCOs were asked if they received any assistance from government programs. TAC was the only ESCO committed to using government incentives to assist its business. The ESCO projects are profitable with savings alone, but by integrating the energy efficiency projects with government initiatives, TAC can also offer broader projects with conversion from electricity/oil and different supply side incentives for biofuels for their municipal customers covered by government initiatives.[193]

There are now two on-going projects in Sweden to promote performance contracting. One of these projects focuses on evaluating performance contracting business models and contract structures with regard to the Swedish market. This project is coordinated by consulting company WSP. This project is funded by WSP, real estate companies, and STEM.[194]

WSP is using a case study of a 2,000 sq. meter building in Stockholm to create a performance contract suited to Swedish conditions and aimed to include innovations. The winner of this contract will deliver energy at the current energy prices at a fixed rate. Twelve companies have received pre-qualification and are currently bidding for this contract.[195] The winner of this contract will provide indoor climate control, energy delivery, and maintenance. According to WSP employee Tomas Gustafsson, the methodology for creating a performance contract for this project comes from three principal sources. First, it starts by project managers asking the building owner what he/she wants. Secondly, many other building owners are also asked what they would like out of this kind of contract. A large number of owners are included in this process so that the results can potentially have broad applications. Building owners involved in this initiative come from diverse areas, including small communities, hotels, military bases, and residential complexes. Finally, the contract type comes from existing structures and permit requirements.[196]

WSP is looking into a variety of activities to include in this pilot contract such as indoor climate, heating and ventilation services, and on-site power generation using solar power and/or pellets. Higher credits will be given to those companies that put larger CO_2 reductions in their proposals. This project will start in November 2003 and the project and final report is expected to be written by February 2006.

The second on-going government project in Sweden concerning performance contracting is being implemented by STEM and the Southeast Sweden Energy Agency or Energikontor Sydost. This project attempts to create awareness of performance contracting and overcome the non-technical barriers to performance contracting.[197]

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[193] Jonas Tegström. Telephone Interview.
[194] Manual Swärd. Personal Interview.
[195] Tomas Gustafsson, Personal Interview.
[196] Tomas Gustafsson, Personal Interview.
[197] Manuel Swärd. Personal Interview.

The first meeting of a reference group for the STEM/Southeast Sweden Energy Agency performance contracting was held on July 2. This meeting dealt with questions such as:[198]

- What is needed by real estate owners to promote performance contracting? What information and interaction (legal, financial, etc.) is needed?

- How to create synergies in the implementation of the two upcoming EU directives on the part of real estate actors? The two directives in question are the energy performance of buildings and the proposed directive on energy end-use efficiency and energy services. According to Manual Swärd of the Southeast Sweden Energy Agency, it is convenient from a real estate owner's perspective to combine procedures involved with these directives. Real estate owners often regard these things as "yet another demand.[199]"

- How to best utilize the Southeast Sweden Energy Agency so that they can insure their efforts are efficient and effective in promoting performance contracting?

The next steps in this process will be to establish a forum, seminars and workshops, and guidelines. The focus will be on the real estate sector, specifically on the public real estate sector. The figure below shows the routes of action and information transfer among organizations. The Southeast Sweden Energy Agency is acting as an intermediary between STEM and the other regional energy agencies. After the project's message and medium to spread this message is decided upon, the Southeast Sweden Energy Agency will spread the capacity they have developed to other energy agencies. These energy agencies will in turn attempt to bring this knowledge to the private market.[200]

[198] Manual Swärd. Personal Interview.
[199] Manual Swärd. Personal Interview
[200] Manual Swärd. E-mail Correspondence.

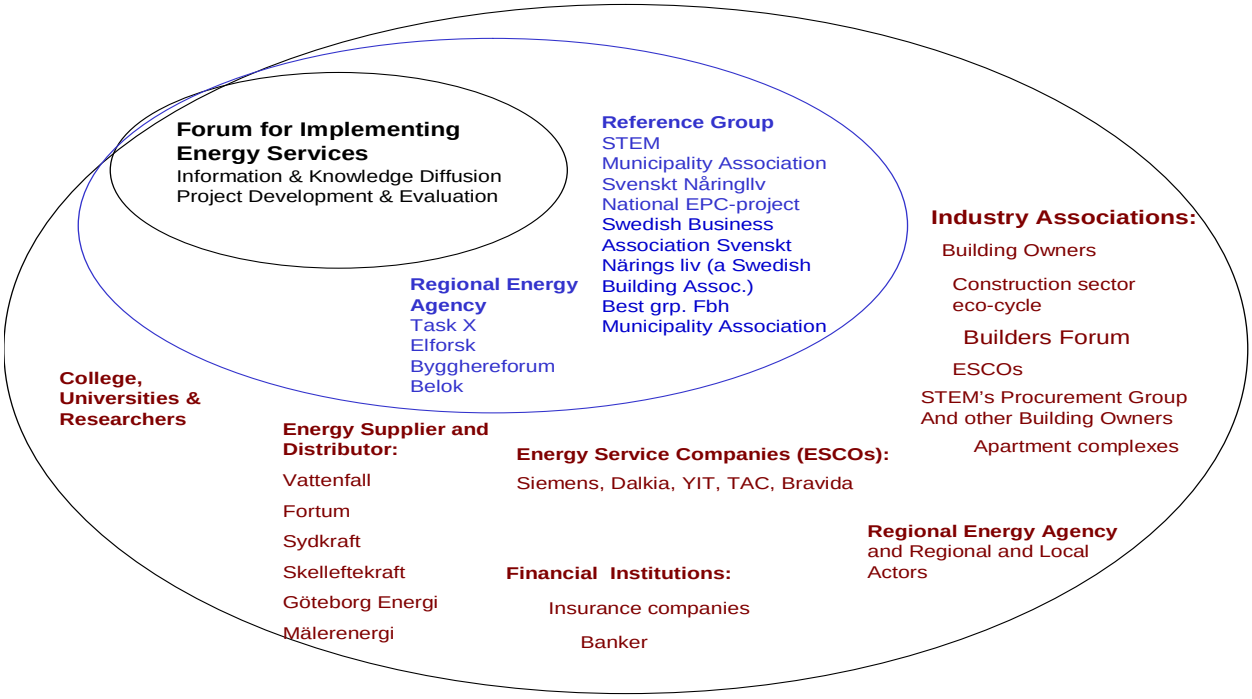

Figure 7-1: STEM and Southeast Sweden Energy Agency Project
Source: Manual Swärd, Southeast Sweden Energy Agency

The three case studies in this research can be shown to illustrate what type of information may be useful for potential ESCO customers. Once the customer possesses knowledge of the ESCO concept then it is useful for them to have knowledge of what services an ESCO can provide, and among these services what services the customer wants or needs. The compatibility and potential fits of the three real estate actors in this study as ESCO customers varied according to their organizational competencies and activities. The table below shows some different services that an ESCO can bring to projects and which of these services may significantly benefit the three Lund real estate organizations, as represented by an X. If organizations have already completed significant steps in a particular service, then they do not receive an X in the box for this service. This is a subjective analysis since it comes from interviews within these organizations and therefore reflects the perceptions of these individuals, and that author's perception of their responses. For example, all three organizations may find significant use of the education services provided by an ESCO, however, only Region Skåne does not have an active education program for their operation and maintenance employees in the area of energy efficiency, therefore they have an "X" placed in their box.

Of course, an actor that has use for a few or all of these services may find the ESCO concept most useful. One can see that the probable first ESCO customer in Lund, Region Skåne, fits such a profile. On the other hand, the demand by a customer for more of an ESCO's services below as compared with other actors says nothing about the relative demand that this customer may have for these services. Some of these services may also differ in their profitability thus making them more valuable for both ESCOs and ESCO customers in general.

Table 10: ESCO Services with an "✓" representing that an organization may find significant value in this service

ESCO Services	Metering	Provide project Investment costs and/or savings guarantee	Adjustment of existing building equipment and systems*	Technical competence in implementing new building equipment and systems*	Education in the operation and maintenance of the facility and in new building equipment systems*	Providing staff for energy efficiency project implementation
Region Skåne	✓	✓	✓	✓	✓	✓
Akademiska Hus				✓		
Lundafastigheter	✓	✓		✓		✓

*The word equipment here is used in reference to singular items such as windows. A system is a broader network of interrelated equipment such as an HVAC system, although this distinction may be blurred.

The table illustrates the customers need to consider the full range of services that performance contracting can provide in order to evaluate whether an ESCO's services would be useful for them. In order to evaluate the value of these options above to their organization potential customers must first know of them and of the performance contracting concept.

Potential Policies to Promote ESCO Markets in Sweden

A review of Bertoldi's strategy plan is given below, along with some citations from other sources for clarification or further information.

1. *Increase Dissemination of ESCO Services and Projects*

2. *Launch an accreditation system for ESCOs (to provide a qualified and reliable service)*

The most successful example of an ESCO association is in the US where the US NAESCO association has 63 members (Goldman 2002). Membership in this association allows a degree of credibility which is beneficial both for gaining customers and for financing projects.

3. *Develop Funding Sources*

Bertoldi (2004) writes that one instrument for developing funding sources would be a revolving fund[201] to finance energy efficiency projects, which has proven successful in Spain.

4. *Standardize Contracts and Monitoring & Verification*

Standardized performance contracts were cited as an opportunity by the IEA DSM Task X report (IEA 2001). A possible drawback with standardizing ESCO contracts is that according to Bertoldi (2004), "this has been an elusive task as various companies consider their contract approaches unique and proprietary." An example of a different and related approach has been taken by the US National ESCO Association (NAESCO), which is now focusing its efforts on creating standard language for important parts of contracts, such as insurance, equipment, and ownership (Bertoldi 2004).

[201] A revolving loan fund begins with government, non-profit, or other institution providing a certain percentage of the total amount of a loan given, and possibly lower interest rates. Private investors are attracted to cover the rest of the loan as the first agent covers the financial risk of the loan. The word "revolving" comes from the fact that once the loan is paid off, then money can be recycled into additional loans (USDA 1996).

Standardized monitoring and verification already occurs in a few different US protocols and in the International Performance Measurement and Verification Protocol (IMPVP 2002). Monitoring and verification allows governments and businesses to justify the economic and environmental benefits of their energy efficiency initiatives, both internally and externally (Hansen & Weisman 1998). In this way standardized ESCO contracts and monitoring and verification would increase confidence in making funds available to ESCOs (IPMVP 2002). The IMPVP is an update of the North American Energy Measurement and Verification Protocol (NEMVP), a document created during the 1990s. The scope of the organization that makes this document, which has the same name as the document, is now a global one that relies on input from around the world to improve this "living document" (IPMVP 2002).

Some sources claim that standardized monitoring and verification (IMPVP 2002) can lead ESCOs to have increased transparency and credibility with financial organizations and customers (IMPVP 2002). On the other hand, in a review of a small sample size in Germany of six ESCOs, eleven potential ESCO customers, and six ESCO customers, Ramesohl et al. (2001) concluded that there was not very much demand for support in monitoring and verification.

5. *Ensure that Governments take the lead with measures in public buildings*

As already explained, public actors typically make good ESCO customers. Public actors also may represent a significant proportion of building markets, and also may comprise a significant fraction of the potential ESCO customer market. According to Bertoldi (2004), a first step in making the public sector "more hospitable" to performance contracting is to remove any institutional barriers that may block its procurement.

6. *Develop a Europe wide Third Party Financing Network*

According to Bertoldi (2004), this network could have a broad scope, including ESCOs, energy suppliers that are interested in energy efficiency, financial institutions, equipment manufacturers, and contractors.

ESCOs and Smaller Customers

The proposed EU Directive on Energy End-Use efficiency and energy services states that (excluding the most energy intensive process industries) "energy services and energy efficiency measures should be offered to all end-use sectors," including small and medium-sized enterprises (Commission Proposal COM(2003)739 final). The proposed directive states that member states should establish "publicly overseen possibilities for energy end-use efficiency, especially for investments with comparatively long payback requirements or high transaction costs" (Commission Proposal COM(2003)739 final). Smaller customers are customers with relatively higher transaction costs in achieving greater energy efficiency. There is no explanation given by the directive on how these energy services and energy efficiency measures will be offered to all customers, or what instrument will be used in order to finance investments with high transaction costs (Commission Proposal COM(2003)739 final).

Judging from the three case studies of actors approaching an ESCO-like business model in 6.3.2, some areas where policy intervention may help promote an ESCO market among smaller customers are:

1. Reduction of transactions costs involved in projects
2. Give policy assistance for ESCOs or actors similar to ESCOs that serve smaller customers and: 1. uses an existing social network, as with E-Ster, or 2. use existing customers, as with YIT (Section 2.6). Both these conditions may serve to lower project costs. A step toward

realizing such a policy would be to investigate what areas of policies or trade associations aimed to assist small actors such as SMEs (small and medium sized enterprises) might be able to be coordinated with the development of the ESCO business model
3. Give policy assistance for existing actors that make up part of the ESCO value chain (e.g. Anti-cimex) or expansion of the role of these actors to include ESCO services. The idea here is that incentives could be provided for businesses to either partner with such an actor or incentives could be provided for this actor to complete the ESCO value chain in its business.
4. Give incentives for "first movers" who attempt an ESCO concept with smaller customers

The bundling of smaller projects into larger projects may be one way to reduce transaction costs involved in these projects (IEA 2003).

An energy supplier such as Lunds Energi is an example of actor that might be able to take advantage of all four of the above criteria due to capacities in its core business (section 4.4). Thus, an energy supplier could serve as a potential pilot project where government assistance in the form of subsidies, tax credits, government loans, or other measures could help test out this potential business model.

As an added benefit, the potential for an actor such as Lunds Energi to become an ESCO actor is especially interesting from a policy perspective in coordination with policies that are designed to support local economies. Money that is earned by local actors is more likely to be spent within a local economy than money gained by an ESCO from outside of the area. This money may be circulated multiple times before leaving the local or regional economy, thus creating a multiplying effect of economic benefits for the local area.[202]

In order for this to work, the energy supplier would first have to convince government institutions and their potential customers that it has a real interest in undertaking such a business model given its core area of focus. Another general barrier for Lunds Energi to be involved with government assistance, according to sales manager Thomas Parker, has been that these projects require long range planning. Lunds Energi makes long range investments, however, they make these investments very soon after they have made a decision to make them. Government assistance programs take longer to develop.[203]

7.3 Policy Recommendations for Growth and Development of the ESCO market in Lund

The potential and existing EU and Swedish policies to promote performance contracting are analyzed in this Section using the three criteria of efficiency, effectiveness, and fairness, and through observations from interviews from representatives from Swedish ESCOs and the Southeast Sweden Energy Agency.

Tradable Certificates

Tradable certificates are a flexible market based instruments where actors are individually given flexibility in order to collectively achieve a goal through the through the allocating function of the private market (Stavins 2003). Under emissions trading in the Kyoto Protocol, this set condition is an allowable level of CO_2 emissions, with trading of CO_2 permits by

[202] This argument is described in Hawken (1993, p. 144-145) and Schuman (1998)

[203] Thomas Parker. Personal Correspondence.

actors involved in this system used to obtain a goal for total CO_2 emissions. Under white certificates, on the other hand, a goal is set for a total amount of reduction in energy use to be achieved. Obligated parties, either power generators or distributors, are required to obtain a certain number of white certificates. These obligated parties can either create greater energy efficiency themselves, a white certificate earned for a specific amount of energy reduced, or buy white certificates from other parties, such as ESCOs, who accomplish this. Both white certificates and CO_2 emissions trading can be regarded as mechanisms that internalize some of the external costs associated with energy production. The proposed EU directive on energy end-use efficiency and energy services, if implemented, would call on member states to adopt general national targets of annual 1% cumulative savings to promote energy end-use efficiency and to ensure the continued growth and viability of the market for energy services (Commission Proposal COM(2003)739 final). One way of implementing this vision is through the use of white certificates, which are already being tested in the UK and are planned to be tested in Italy. The Swedish government is currently considering the use of white certificates.

Both emissions trading and white certificates can help make investments in energy efficiency more cost-effective. They both give an extra economic incentive, in the form of a certificate that can be traded for money, for actors such as ESCOs that reduce energy consumption and CO_2 emissions. The ESCO concept is especially useful for both of these tradable schemes due to its ability to monitor and verify the savings that have occurred in energy or CO_2. More transparent and standardized monitoring and verification procedures can add further credibility to show that ESCOs (or other actors) are really earning benefits they receive from these certificates (IMPVP 2002).

Interviewee Responses

Interviewees from Swedish ESCOs, Lund real estate organizations, and the Southeast Sweden Energy Agency were asked what the current barriers and policy opportunities are for performance contracting in Sweden. A few common barriers were a lack of knowledge by customers concerning performance contracting, and the lack of standardized public ESCO contracts. Frank Johansson from Siemens cited the success of Siemen's performance contracting business with public actors in Germany using standardized government contracts as a reason why this would a good idea for Sweden.[204] The attitude of interviewees in relations to energy prices is harder to generalize. Some interviewees regarded energy prices as a barrier to greater procurement of performance contracting; however, some interviewees described energy prices as more of a historical barrier than a current one given the trend of rising energy prices.

Policy Evaluation Criteria

In general policies can be evaluated according to:

Effectiveness – Does this policy accomplish its goals? In this case, the goal is to determine policies that would have the greatest impact in developing and growing an ESCO market.

Efficiency – Does this policy accomplish the best result using the least possible resources? Resources involved may be financial resources, labor (e.g. administration), and capital. Additional resources may be the factors of political will and time.

[204] Frank Johansson. Personal Interview.

Fairness – Are the costs of the policy (e.g. taxes) placed heavily on one group and are the benefits largely excluded from another group? Exclusion indicates here that stakeholders do not have equal opportunity to the benefits of a policy.

These policies will first be evaluated in a more general Swedish context, and then evaluated based on the Lund context.

Effectiveness

The rows in Tables 9 and 10 below provide a list of general energy and ESCO policies, as given in sections 7.1 and 7.2. The factors given in sections 6.1-6.3 as critical for the development of energy savings potentials, legal, organizational, and market conditions for ESCO greater growth and development of ESCO markets are given in the columns of these three figures.

The ability of different policies to encourage potential ESCO customers to procure ESCOs is given in the figure below. An "X" indicates this policy can help make this factor more suitable for performance contracting

Table 11: Policies and Factors within Organizations for ESCO Procurement
"✓" indicates this policy can help make this factor more suitable for performance contracting

ESCO Policies
Effectiveness – Potential ESCO Customers
Organizational Factors

		Cost & Priorities	Short-term Political Interest	Lack of Knowledge	Perceptions of ESCOs
Energy Policies	Energy Taxes				
	Product Efficiency Standards				
	EU Directive on Energy Performance of Buildings				
ESCO Policies	Standardized Monitoring & Verification Protocols				
	Standardized ESCO Contracts				
	Strategic Increased Dissemination of Information on ESCO Concept			✓	✓
	ESCO Accreditation and/or Association			✓	

One can see from Table 8, that the given policies given do not have much of an anticipated effect on the barriers within organizations, with the exception of strategically targeted information that is able to increase the knowledge of the ESCO concept. Information related policies are stated in the table as possibly alleviating of negative perceptions and/or a lack of knowledge of ESCOs within organizations. However, if an organization has negative perceptions of the ESCO concept that are rooted in valid threats to their business, such as the fact that they do not want to outsource their core activities (e.g. management of a building), then information may not have an effect.

The word "strategic" in "strategically increased dissemination of information on the ESCO concept" is intended to reflect that information campaigns are not effective by simply providing information. For example, Malcom Gladwell (2000) gives three key factors for the

successful and rapid spread of ideas: the context within which information is provided, the power of a few well connected and influential people to have a great effect, and whether an idea is "sticky" or memorable and catchy. A practical example of an information campaign that uses what Gladwell describes as the power of a few influential and well connected people in spreading ideas is Lund University's upcoming marketing efforts for achieving greater energy efficiency. This program will focus on the "trendsetters" within the field of the IT sector as the core focus of a new information campaign on energy efficiency.[205] The idea here is that by focusing education efforts on the people that others follow, that this campaign will have a greater power to produce a greater effect.

Table 12: Policies and Market Factors for ESCO Procurement
"✓" indicates this policy can help make this factor more suitable for performance contracting

	Policies	Market Factors				
		Lack of Information	Perceived Risk	Transaction Costs	Energy Prices	Reaching Smaller Customers
Energy Policies	Energy Taxes				X	
	Product Efficiency Standards					
	EU Directive on Energy Performance of Buildings			X		
ESCO Policies	Standardized Monitoring & Verification Protocols		X			
	Standardized ESCO Contracts for Public Actors		X	X		
	Strategic Increased Dissemination of Information on ESCO Concept	X	X			
	Demonstration Projects	X				X
	Develop Funding Sources					
	ESCO Accreditation and/or Association		X			

Table 13: Policies and Financial and Legal Factors for ESCO Procurement
"✓" indicates this policy can help make this factor more suitable for performance contracting

[205] Kerstin Gustafsson. Personal Interview.

ESCO Policies
Effectiveness – Financial & Legal Factors

		Establishing Collateral/Customer Project Investment	Ease of Public Procurement	Financing (General)
Energy Policies	Energy Taxes			
	Product Efficiency Standards			
	EU Directive on Energy Performance of Buildings			
ESCO Policies	Standardized Monitoring & Verification Protocols			✓
	Standardized ESCO Contracts for Public Actors		✓	✓
	Strategic Increased Dissemination of Information on ESCO Concept			✓
	Demonstration Projects			✓
	Develop Funding Sources			✓
	ESCO Accreditation and/or Association			✓

As can be seen from the tables above, standardized ESCO contracts and the strategic dissemination of information on the ESCO business concept receive the most number of X's. The analysis in these two tables assumes a best case scenario in which these instruments would be effective. For example, it is clearly a challenging task for an information related initiative to go beyond simply providing information and actually inspire greater trust.

Standardized performance contracts are viewed to indirectly affect the barrier of public procurement laws. Since public actors in Sweden currently already procure performance contracting, then changing public procurement laws may be unnecessary. What potential customers need is a road map in dealing with public procurements laws. One way of accomplishing this is through standardized performance, although the possibility remains that a simpler solution can accomplish this goal. Therefore, in the case that this option exhibits a great deal of cost, time, and/or resistance; then simple guidelines and advice on how public organizations can procure performance contracting may be a more efficient option.

The power of a standardized government contract to increase assurance and correspondingly lower risk involved in projects may also serve to give financial institutions more confidence in performance contracting. This could serve to form a possible reinforcing feedback loop, as shown in the figure below.[206] The strength of any reinforcing causal loop is relative to the counterbalancing forces acting against it (Senge 1990, p.83). In this case counterbalancing forces may come from the already mentioned various financial, legal, organizational, and market factors that can serve to inhibit procurement of performance contracting.

[206] The two causal loop diagrams in this section are based on, but are formed differently, and reach different conclusions from
the systems analysis of ESCO created by Dr. Hameed G. Nezhad in his powerpoint presentation "Analysis of the main driving forces of the Energy Efficiency Market in the Philipinnes." In *Roundtable on Energy Efficiency Planning and Market Development Strategies,* Manila, May 18, 2004. [Online]. Available: http://www.adb.org/Documents/Events/2004/Roundtable-on-Energy/Session-II.pdf

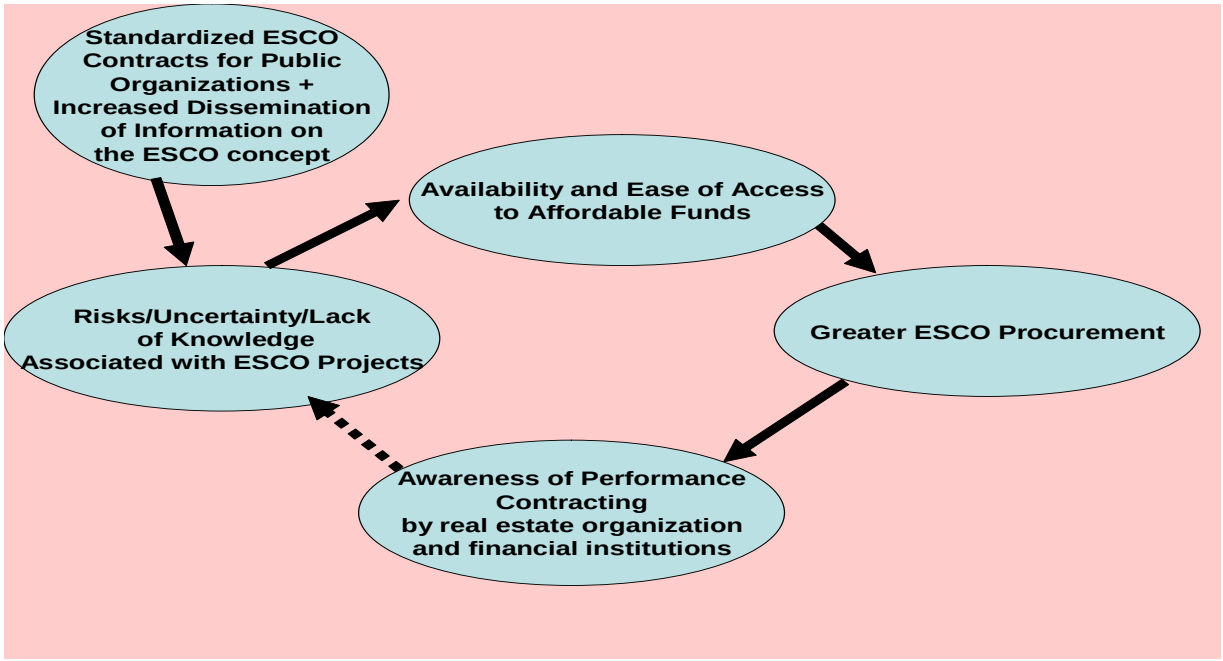

Figure 7-2: Possible Causal Relations Initiated by Standardized Public ESCO Contracts

It should be noted that the ability of a policy to influence a number of variables, possibly in a reinforcing feedback loop, should not be confused for necessarily being more effective than a policy that addresses the root causes of barriers in a system, such as the price of energy (section 6.1). Changes in energy prices may not directly produce any structural changes in an ESCO market. However, indirect changes to the structure of this market will likely result as a result of changes in energy prices, depending on the amount and speed of these changes. Senge (1990, p. 44) defines structure as:

Systemic structure is concerned with the key interrelationships that influence behavior over time. These are not interrelationships between people, but among key variables, such as population, natural resources, and food production in a developing country…

Energy prices are recognized as a fundamental variable in the performance contracting market as shown by a possible causal relationship shown below. Energy taxes directly affect the price of energy. Emissions trading and white certificates do not directly affect the price of energy supplied, however, they affect the cost of saving energy, and thus the ratio between the cost of supplying (or buying) energy versus saving it.

Figure 0-1: Possible Causal Relations Initiated by the Introduction of Standardized ESCO Contracts

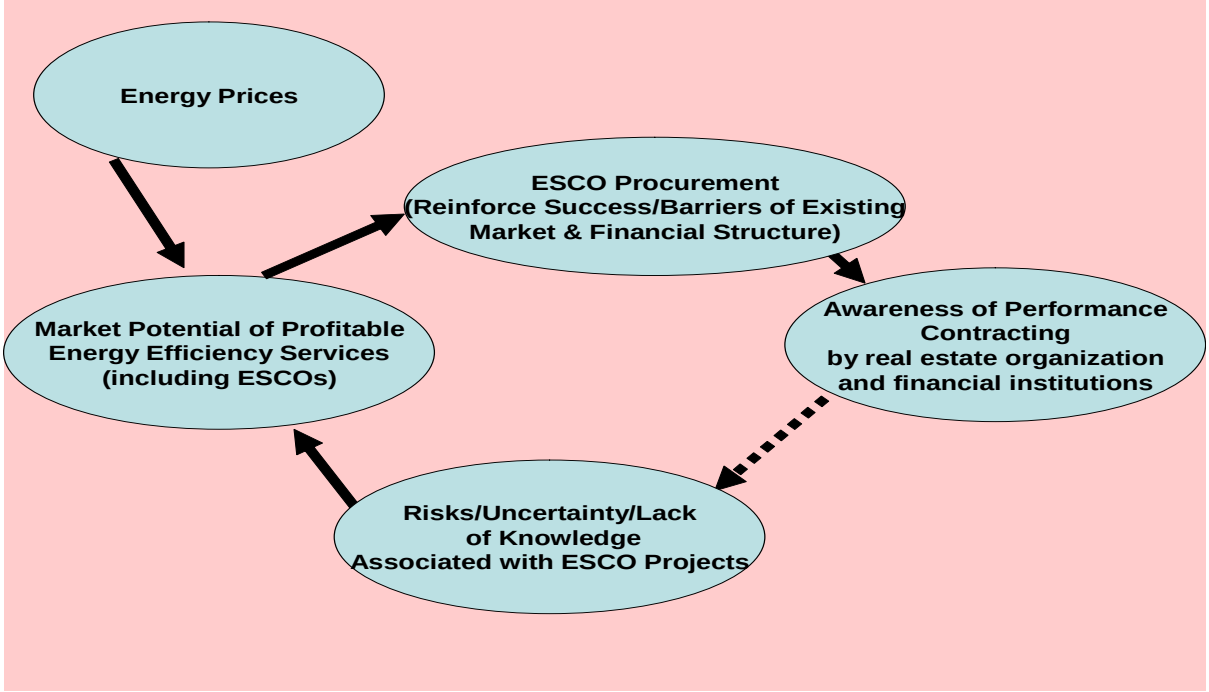

Figure 7-0-2: Possible Causal Relations Initiated by Changes in Energy Prices

Within the context of Lund, the example of Region Skåne can illustrate how targeted information and solutions for dealing with public procurement laws would be the most effective initial steps to assist an ESCO market in Lund. First, ESCOs contacted Region Skåne first, which represents the usual case in the Swedish ESCO market where the ESCO typically contacts the customer. This also indicates that demand side and not supply side solutions may be the strategic area to first concentrate efforts. This initial contact sparked Region Skåne's demand for ESCO services. Strategic information on the ESCO concept could help spark more customer demand so that customers may contact ESCOs first, serving to create more performance contracts in the market. Secondly, the biggest obstacle that Region Skåne encountered in buying an ESCO's services was dealing with public procurement laws.

Guidelines, assistance, and/or standardized contracts for public procurement of performance contracting would make this process easier. Under the current market conditions, new solutions have to be worked out for each contract between the ESCO and its public customers. A standardization of ESCO public contracts could give these contracts greater credibility and make it easier to compare the services of different ESCOs. This could make the ESCO business concept gain customers faster and become an easier "sell" for those within real estate organizations to their boards and co-workers.

Efficiency

It is difficult to provide an analysis of the costs, and therefore efficiency, of these polices in a Lund context. A critical factor in many of these policies is the preferences of the ESCO industry, since they will be crucial stakeholders in policies such as the formulation of standardized contracts and/or monitoring and verification, ESCO accreditation.

In order to use least possible resources to grow and develop the ESCO market in Lund, it is easiest to take the steps first that complement existing efforts outside of Lund. This can be done by coordinating Lund organizations with existing efforts of the STEM/Southeast Sweden Energy Agency project to increase the dissemination of information on performance contracting using materials, and if possible, with the WSP project.

Fairness

Policies to promote performance contracting may be efficient and effective, but at the moment, they are not fair in that they exclude large segments of real estate actors, including small businesses and the residential sector.

Conclusion

The policies of strategically targeted information and standardized public performance contracting (or some other means of assistance with public procurement of performance contracting) are considered by this research to be the most effective and efficient steps to be taken in further developing an ESCO market in Lund and in Sweden. In the absence of identifying any policies that might specifically aid a Lund ESCO market, the most efficient step for stakeholders in Lund to take in developing this market is to become involved with the existing initiatives of STEM/Southeast Sweden Energy Agency and/or the WSP project demonstration project.

Finally, although the definition of what is and is not an ESCO may be important for defining policy goals and implementing certain policies, such as the creation an ESCO association, standardized contracts may accomplish this in a defacto sense. This is because any actor that is able to meet the requirements of the standard contract and is hired by the customer may be considered an ESCO. On the other hand, a possible drawback of creating standardized performance contracts is that the ability of performance contracting business models to evolve (e.g. to include small-scale renewable energy delivery) might be inhibited by a confining standardized structure. This argument therefore can be used to help justify: 1. Demonstration projects (such as the WSP run project) that help further develop the scope of the ESCO business model, and 2. The periodic adjustment of standardized performance contracts to include new parameters.

A Framework for understanding policies and actions growth and development of ESCO markets

To illustrate how these different policies may work together to alleviate barriers for performance contracting in Sweden, they are organized below according to Meadow's framework (1999). The figure given by Meadows (1999) below, lists the top six leverage points to intervene in any system. Meadows describes leverage points as "places within a complex system where a shift in one thing can produce big changes in everything" (Meadows 1997). The system here is the ESCO market and the larger energy market that it is a part of. The point of this exercise is to encourage the reader to think about what different policy actions may be accomplishing or have the potential to accomplish, not for the reader to focus efforts on criticizing the placement of these policies. According to Meadows (1997), the order and boundaries among different numbers in the above framework may be blurred, as with any model.

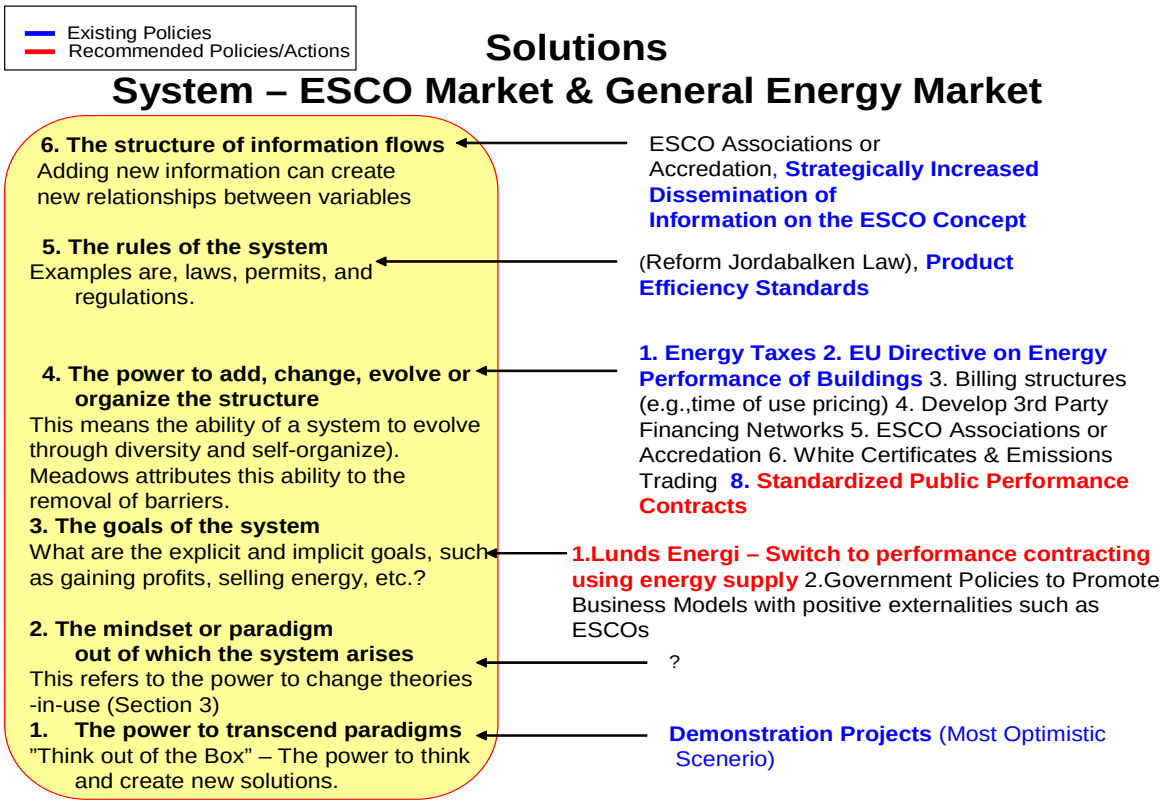

Figure 7-0-3: Meadows Framework (1999), and Existing and Potential ESCO Policies

Some explanations of this table are necessary:

Demonstration projects with very creative and effective ideas and implementation may have the ability to change the idea of what is possible. However, a weakness of demonstration projects is that they may remain demonstrations when these projects do not lead to imitation or lessons learned that are practically applied in other cases. Without changing the structure of a system (or possibly the goals, rules, etc.), the creative ideas behind demonstration projects may not be able to be implemented. If, on the other hand, demonstration projects are able to find a new way of working within an existing system, then this may be their greatest chance of having power to change this system.

The use of the ESCO concept by an energy supplier is viewed to have the potential to begin to change the present goals involved with the delivery of energy. Currently this system of energy delivery has as one of its primary goals "to sell the product of energy in units (kWh)." A new system goal could be "to sell services such as heat, light, etc", or the service of reductions in energy consumption, or as Amory Lovins (1996) calls them "negawatts," instead of selling the products units of kilowatts.

This fundamental change in goals is not likely to change from simply having energy suppliers deliver energy efficiency services as a non-primary function, as has already happened in the Swedish energy market. This is because, according to interviews with Swedish energy companies, the overriding goal of the system, to sell more energy, will remain. Two reasons why this is the case can be illustrated using the example of Lunds Energi. The internal management and culture of this energy company is orientated towards energy supply, and the customers have a skeptical mindset toward the possibility of an energy supplier reducing their

demand for energy. Thus, even if explicit goals of an energy company change to reflect the sale of performance contracting, the internal tacit assumptions and beliefs (theories-in-use) of this company and their customers and potential customers may make these explicit goals difficult to achieve.

However, structural changes to the way that energy is sold may open up the possibility of the goals of this system to slowly change. The structure of performance contracting in spreading out the customer's initial investment in changing sources of energy supply is only a slight change, in that the product being sold is still the supply of energy and not "negawatts." However, this structure, performance contracting, would possibly make it easier for energy suppliers to sell energy efficiency services along with the product of energy because the interest by both the customer and supplier is changed from the very short term payment time - the installation payment (in the case of fuel switching) and kWh sold - to the longer term total costs of energy over time. When energy costs are viewed in this longer term context, then it can be easier for all actors to see and implement investments in energy efficiency. The advantage of this form of contract over another long term energy management contract type, facilities management, is that the revenues of an ESCO are directly tied to and originate primarily or only from savings that are achieved.

8 Conclusions and Recommendations

8.1 Conclusions and Recommendations

Real Estate Actors

All three Lund real estate actors in this study exhibited some similarities in their experiences with energy efficiency. The main factors identified in this study for these organizations in achieving toward greater energy efficiency for one or all of these organizations are listed below. These factors, with the exception of the first one, are for both greater heat and electricity efficiency.

Billing Structures, Fixed and variable electricity pricing - The marginal cost of electricity is not reflected in the price.

Billing Structure, Split Incentives – Neither tenants nor a building's owner/operator/investor have an incentive to invest in energy efficiency as the billing structure does not allow them to adequately recover and profit from this investment

Power - Political barriers in that short term political cycles make it difficult to have a long range plan or vision for energy efficiency in municipal buildings

Priority and time - Priority is given to other investments closer to the organizations' core competence. This can be reflected by strict payback requirements for investments in achieving greater energy efficiency. Also, there is a lack of available staff to implement energy efficiency projects

Availability, quality and access to information - Metering of energy use is not checked, not working properly, and/or is in too few areas to determine an adequate picture of energy use and estimate cost-effective energy reducing investments

No conclusions were arrived upon for two of the other factors given in the theoretical framework on energy efficiency in organizations, transaction costs and accounting practices. Since the biggest changes that Region Skåne (possible ESCO project) and Lundafastigheter (billing structure) are implementing are happening now, then it is too early to make such an analysis. Akademiska Hus has made significant continual improvement in the past decade toward reducing its energy use by adjusting its existing equipment and building systems. Head of technical administration Roland Larsson felt that most of the "lower hanging fruit," – in this case adjustments to existing buildings systems and equipment that require less effort and achieve good returns on investment – have been picked. However, since Akademiska Hus is undergoing major improvements in giving their tenants more incentive to reduce energy and giving Akademiska Hus greater knowledge of their energy use, then there is it is likely that this organization will continue its on-going improvement toward achieving greater energy efficiency.

One case of split incentives in literature was observed with Lundafastigheter and another case which is close to or represents split incentives was observed with Region Skåne. Billing structures and incentives were perceived by interviewees as a strong factor in influencing the behavior of tenants and influencing investment patterns in energy efficiency. An illustrative case is of this is that many of RegionFastigheter's tenants have already reduced their budgets in anticipation of an upcoming billing structure that will allow for an increased correlation and

decreased time delay between the consumption of energy and payments that correspond to this consumption.

Performance contracting can alleviate barriers in access to capital. The remaining main factor of fixed energy prices that do not reflect its marginal cost involves the price of energy and is considered outside of the scope of an ESCO's activities, except in the possible case of an energy supplier who has the ability to adjust rate structures. This factor could be practically addressed by the use of time of day pricing. Interview respondents generally preferred fixed electricity prices as opposed to time of day pricing due to its perceived greater simplicity and convenience.

Akademiska Hus i Lund has a fair amount of existing capacity and on-going activities in implementing energy efficiency. Judging from the past experience of the Akademiska Hus organization in Lund and from the experience of their location under the same management in Kristianstad, an ESCO's services may be most useful in providing technical expertise in the implementation of new buildings systems and equipment. On the other hand, given its existing strengths Akademiska Hus also can concentrate its efforts on its growing internal capacities, without outsourcing. One way to aid this development might be through the use of the "internal ESCO" or intacting concept. This would allow a more direct transparency between investments in energy efficiency (and possibly environmental management in general), and the gains from these investments.

Lundafastigheter is focusing its efforts toward achieving greater energy efficiency through the use of existing resources in their buildings and training their staff. A number of factors are shown to inhibit this organization from taking on further investment in upgrading their existing equipment and systems and/or investing in new equipment and systems.

A recommendation is that Lundafastigheter invite an ESCO to conduct a preliminary analysis of their buildings.

A preliminary analysis offers some general predictions on the energy savings potentials, payback times, costs, and length of the project. It is recommended that Lundafastigheter choose an ESCO to conduct this analysis separately from the contract as a whole, with right to leave the contract after it is performed. This would give Lundafastigheter the chance to evaluate the potential costs and benefits of an ESCO contract.

Region Skåne is currently in the beginning stages of a possible ESCO project. This organization was able to overcome difficulties with public procurement laws by writing a bid for public procurement that asked for specified services instead of an undefined product. This case demonstrates how organizations can work around real or perceived legal or other obstacles confronting their procurement of performance contracting.

Lunds Energi possesses or can possess a significant amount of strategic advantages as a potential ESCO through tools from their core business as an energy retail supplier. There are relatively small reductions in energy consumption that can be made to achieve significant financial savings during winter months for oil and electricity production, and during summer months for oil, electricity, and natural gas production. However, their identity and corporate culture as an energy supplier could make a move to incorporate performance contracting into their business difficult. A possible low risk strategy for Lunds Energi to incorporate the ESCO concept into their business would be for Lunds Energi to have an outside actor conduct the demand-side project management, while Lunds Energi could run the supply side switch from oil to district heating. These outside actor or actors could split the profits from the demand

side measures with the customer, possibly giving an added payment to Lunds Energi for providing them with this business. This strategy might calm any doubts by the customer that Lunds Energi, an energy supplier, could deliver demand-side solutions.

If Lunds Energi is to become an ESCO, then a recommended first step is for them to first determine which areas of its present capacities (sections 4.4.1 & 4.4.2) can be used for performance contracting. Next, the use of the ESCO business concept can be used in conjunction with the conversion of their customers from oil to district heating.

The energy service company market in Sweden is an emerging one. According to interviews with Swedish ESCOs, substantial cost-effective energy savings potentials are common in the Swedish market across different sectors. Energy savings potentials were estimated by Swedish ESCOs and a company that as one of its activities conducts building transfers and sometimes conducts energy audits with these building transfers. In all but one case (for newer buildings) savings potentials were generally estimated to be well over 10% of annual energy bills in Swedish buildings. ESCOs surveyed generally accepted payback times between five and ten years for installed measures, although one ESCO required a payback time of a maximum of three years.

Given the existence of cost-effective savings potentials, performance contracting can help alleviate planning, financial, technical capacity, and lack of staff or staff availability barriers to energy efficiency within organizations as described above. Barriers for this market in Lund and in Sweden as demonstrated by interviews with real estate actors and Swedish ESCOs and literature are:

Organizational Barriers
Organizations usually give greater focus on their core activities and the associated costs, which may inhibit interest in profitable ESCO projects. Long term will from politicians for energy efficiency may be difficult to achieve within public organizations given short term political interest.

Financial and Legal Barriers
In Sweden there is a Jordabalken law or "Code of Land Law." This law inhibits companies from taking back items that have been installed in a building that can be considered "part of the building" (IEA 2001). The IEA Demand Side Management Performance Contracting Report for Sweden lists this condition as a general barrier for performance contracting in Sweden. It remains an area of further research to determine how collateral laws could be changed so as to encourage greater financing of ESCO projects by ESCO customers. This could serve to lower the total costs involved in projects and make it financially easier for new ESCOs to enter the market.

The need for public actors to develop solutions around the Swedish law of public procurement may in some cases inhibit these actors from attempting ESCO procurement

Market Barriers
Lack of knowledge by potential customers of the ESCO concept, transactions costs, and perceived risks associated with ESCO projects are all market barriers for greater ESCO procurement. Globally, a barrier for the further development of the ESCO business model and ESCO markets is the difficulty in providing energy services to smaller customers due to high transaction costs and lower potential returns. These barriers were observed in four Swedish ESCOs interviewed who require that customers should have at least 100,000 square meters or have a minimum yearly energy savings potential of 100,000 SEK. An explorative

approach was taken to attempt to identify a case where an ESCO used smaller customers. No performance contracting business models were identified in these three cases.

Actions and Policy Options for further Growth and Development of ESCO markets

Despite the barriers listed above, there is no evidence to suggest that they are insurmountable for a customer over a certain size. Even though the obstacle of public procurement laws has been overcome by Region Skåne and others, a quicker contract process can make performance contracting easier for ESCOs and their customer and all the Swedish ESCO market to grow more quickly. Policy tools and instruments can be used to quicken and simplify this process. In the past, initiatives in energy efficiency in Sweden have often achieved initial success but fail to show continuous progress after the projects stop.[207] Promoting a private market tool for energy efficiency ESCOs may serve as a way of having a more long term strategy in this market. In a qualitative analysis with efficiency, effectiveness, and fairness as criteria, standardized performance contracting and the strategic increased dissemination of information on the ESCO concept were found to be the most desirable policy instruments to pursue.

1. The first step toward achieving greater growth in the Lund and Sweden ESCO markets is to increase the knowledge of this business concept. Potential customers cannot hire an ESCO if they have not heard of this concept, or if an inadequate understanding of the concept leads them to dismiss it. Increased knowledge dissemination is one of the goals of an initiative in its early stages between STEM and the Southeast Sweden Energy Agency.

2. A second step toward achieving greater ESCO market growth in Lund and in Sweden is for the creation of standardized performance contracts using successful examples in other countries. Under the current conditions, new solutions have to be worked out each time between the ESCO and its customer. A standardization of ESCO contracts could give these contracts greater credibility and make it easier to compare the services of different ESCOs, and thus make the ESCO business concept gain customers faster and become an easier "sell" for those within real estate organizations to their boards and co-workers.

Development
The development of the ESCO market to include retail energy suppliers as ESCOs and smaller customers as part of the customer base would be two significant steps. Three businesses with models close to the ESCO concept are used to provide some basic conclusions on what a policy would consist of to further develop an ESCO market to include smaller customers, although no specific policy is identified. An policy that would assist the development of ESCO markets to include smaller customers could focus on:

1. Reducing transaction costs involved with these projects. The EU Directive on energy performance of buildings may serve to reduce transaction costs involved in energy efficiency service projects since energy audits are required by this directive. This creates the opportunity for the energy auditor or a second actor to complete the rest of an ESCO value chain.

2. Provide incentives for existing ESCOs that serve smaller customer, for actors deliver services to smaller customers and make up part of the ESCO value chain to expand this value chain either through their own business or with cooperation of another actor, and first movers that make an attempt to provide these services

[207] Manuel Swärd. Personal Interview.

3. Provide incentives for programs and trade associations that already serve to promote development of small and medium sized enterprises and local business to include the development of ESCO markets to include smaller customers.

This research analyzes the potential for Lunds Energi to become an ESCO. Currently, the existing ESCOs supplying this service would have to come from outside Lund. Substantial barriers exist for Lunds Energi to expand its business concept to include performance contracting. However, there is much opportunity for this actor to succeed using its existing customer base and useful existing competencies. To expand the scope of ESCO suppliers to include district heating producers in Sweden would be a significant development from the current limits of the municipal district heating business and general energy supplier business model boundaries. It would also be a significant step in the development of the ESCO market both in Lund and other areas.

8.2 Areas for Further Research

- One interview respondent observed that a barrier to performance contracting in Sweden was that the building market contains a disproportionate amount of buildings that have the same owner and operator when compared with other countries. An area of further research would be to investigate the validity of this statement.

- What ESCO business model can deliver services to smaller customers? What policies might assist this development?

- What ESCO business model can be used in combination with the core business of a district heating company or other energy supplier? What policies might assist this development?

- How do legal structures and practices in countries outside of Sweden handle the issue of collateral in performance contracting?

- Are Swedish local climate investment funds, KLIMP, a useful tool for increasing ESCO procurement, and/or increasing the scope of the ESCO market to include energy suppliers as ESCOs, and/or smaller actors as ESCO customers?

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Abbreviations

CAV Constant Air Flow

HVAC Heating Ventilation and Air Conditioning

IEA International Energy Agency

VAV Variable Air Flow

Appendix 1. Interviewees and the main topics of interviews

To avoid redundancy, the following main topics of discussion are listed as being discussed with for different categories of interviewees.

General

- Energy savings potentials within the organization being interviewed, Lund, and Sweden.
- Can an energy supplier become an ESCO? (How would your organization respond to this as a customer or as an ESCO?)

Swedish ESCOs

- Experience, opportunities, and barriers in the Swedish ESCO market
- What would you say are the minimum conditions that a company needs to meet in order to become an ESCO?
- How many projects do you have now and have you had in the past?
- What is your general business concept? (e.g. project costs, financing, contract structure)
- List of ESCOs in Sweden
- How is the business case for energy efficiency different for electricity and heating?
- What are the conditions that a potential customer must meet in order for you to be involved in a project? What is your ideal customer profile?
- Has your company had any relationship during any of your projects with energy companies (retailers, utilities)?
- Do you receive any government subsidies or incentives?
- Please explain how you go about monitoring and verifying energy savings?

Lunds Energi

- Investment in new production capacity and potential for expansion of customer base
- What knowledge does Lunds Energi have of their customer's energy profiles?
- Can Lunds Energi provide ESCO services?

Lund Real Estate Organizations

- General description of the organization and its activities
- What is your price and billing structure for buying or selling energy?
- The experience, barriers, and opportunities of each organization from energy efficiency from financial, social, business, and technical perspectives.
- How can or does this organization profit from reducing its energy use?
- What are your requirements for potential customers?

Interviews

In person

20040616 **Björn Alm**, bjorn.alm@lund.se, Lund Energy Advisor, Lund Municipality

20040623 **Rolf Månsson**, rolf.månsson@lundsenergi.se, Production Manager, Lunds Energi, with **Lena Slovak,** Environmental Manager, Lunds Energi

- Lunds Energi Energy production facilities tour

20040624 **Kerstin Gustafsson**, kerstin.gustafsson@bygg.lu.se, Environmental manager at Lund University

20040628 **Suzanne Anderson,** District Heating Sales, and **Lena Slovak,** Environmental Manageer, Lunds Energi
lena.slovak@lundsenergi.se, suzanne.anderson@lundsenergi.se

- Lunds Energi District Heating Business

20040630 **Sigvard Strelert**, sigvard.strelert@lundsenergi.se, Electricity Sales, Lunds Energi

- Electricity price structure

20040707 **Philip Altenhammar**, operations and maintenance engineer, and **Johnny Ask**, engineer, Akademiska Hus
philip.altenhammar@akademiskahus.se, jonny.ask@akademiskahus.se

- Lunds Energi District Heating Business
- What knowledge does Lunds Energi have of their customer's energy profiles?

20040708 **Åke Blomsterberg**, ake.blomsterberg@wspgroup.se, WSP and Lund Institute of Technology, Department of Energy and Building Design

20040711 **Birgitta Wickman**, birgitta.wickman@akademiskahus.se, Environmental Manager, Akademiska Hus

20040711 **Hakan Segerholm**, hakan.segerholm@lund.se, Lundafastigheter, Engineer

20040721 **Mats Olsson**, mats.olsson@lundsenergi.se, Production Manager, Lunds Energi

- Marginal costs and production patterns of Lunds energi district heating Production

200407?? **Lars Göran-Nilsson**, Lars-Goran.Nilsson@lundsenergi.se, Sales, Lunds Energi

20040809 **Rowan Wright**, rowan.wright@lund.se, Project Leader – Energy Smart Schools, Lundafastigheter

20040816 **Steffan Görtz,** steffan.gortz@vattenfall.se, and **Thomas Davy**, thomas.davy@swedpower.vattenfall.se, Vattenfall

- Swedish energy market trends
- Vattenfall and energy efficiency services
- Prior experience at the energy company Sydkraft (both are former Sydkraft employees)
- Can an energy retail supplier provide energy efficiency services as a stand-alone profitable business in the deregulated Swedish market?

20040823 **Robert Johansen**, Robert.Johansen@skane.se, Chief Property Manager, RegionFastigheter

20050825 **Manuel Swärd**, manuel.sward@energikontor-so.com, Deputy Manager Southeast Energy Agency and National Manager Capacity Building Energy Services

- Most of the same questions given to Swedish ESCOs
- Southeast Sweden Energy Agency/STEM ESCO capacity building project

20040827 **Frank Johansson**, frank.johansson@siemens.com, Siemens, Performance Contracting Manager

20040827 **Fredrick Lagergren**, Fredrick.Lagergren@es.kth.se, KTH (Royal Institute of Technology in Stockholm) Executive School

- Lagergren's (2004) doctoral thesis research
- Swedish building market and energy efficiency services

20040920 **Roland Larrson**, roland.larrson@akademiskahus.se, Director of Energy Management, Akademiska Hus

By telephone

20040608 **Paolo Bertoldi**, paolo.bertoldi@cec.eu.int, EU Joint Research Commission, Institute for Environment and Sustainability.

- ESCOs and smaller customers
- ESCOs and real-time pricing
- ESCO business model

20040614 **Wim de Groote**, wimdegroote@pandora.be, Co-Founder and Co-Owner/Operator, E-Ster

- E-Ster experience and business model
- ESCOs and smaller customers

20040622 **Wolfgang Irrek**, , wolfgang.irrek@wupperinst.org, Wuppertal Institute

- Experience of the German ESCO market
- Mr. Irrek's masters thesis research related to ESCOs

20040705 **Alf Persson**, alf.persson@anticimex.se, Anti-cimex

- Anti-cimex business concept
- Implementation of the EU Directive on energy performance of buildings

20040702 **Stig Hoff**, stig.hoff@akademiskahus.se, Akademiska Hus

- How Akademiska Hus buys electricity externally and internally and sells electricity internally

20040706 **Tomas Gustafsson**, Tomas.gustafsson@wspgroup.se, Environmental Manager, WSP

- ESCO Demonstration Project

20040824 **Jonas Tegström**, Jonas.Tegstrom@tac.com, Performance Contracting Manager, TAC.

20040907 **Leif Lenman**, leif.lenman@fm.skanska.se, Skånska, Facilities Management Manager

20040910 **Mats Samuelsson**, mats.samuelsson@anticimex.se

- Anti-cimex business concept
- Implementation of the EU Directive on energy performance of buildings

20040910 **Lennart Berndtsson**, lennart.berndtsson@hsb.se, Director of Energy Management, HSB

- Energy management at HSB
- Energy savings potentials in HSB apartments

20040915 **Anders Nygren**, anders.o.nygren@yit.se, YIT

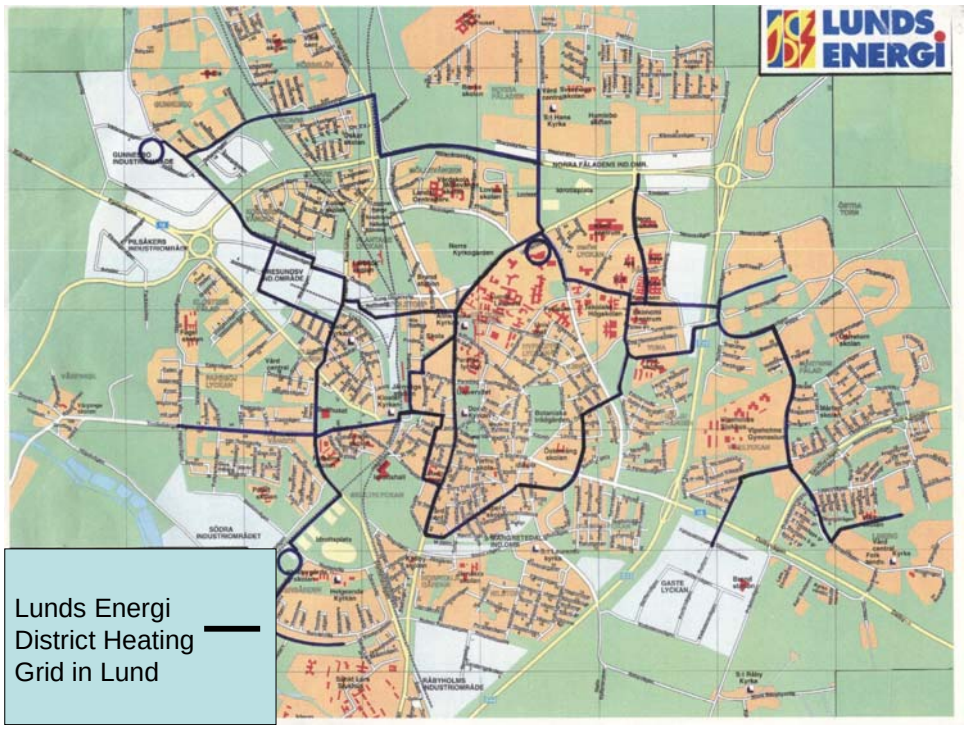
By E-mail

Phillippe Redlich, Philippe.redlich@freenet.de, Energieberatung

Dr. Werner Neumann
werner.neumann.amt79a@stadt-frankfurt.se, Founder of Energieberatung (SparWatt)

- Energieberatung experience and business model

Appendix 2. Lunds Energi


LUNDS ENERGI
Lunds Energi
District Heating
Grid in Lund