The energy-service gap: What does it mean?

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Abstract

Through the formulation of the 2020-targets, the EU has set as an objective to reduce the use of primary energy with 20 % by 2020. The target is supposed to be reached through increased energy efficiency. Despite a large potential for energy efficiency, cost effective measures are not always implemented which is explained by market failures and barriers to energy efficiency. This difference between potential energy-efficiency and what is actually implemented, is referred to as the energy-efficiency gap. Energy service companies (ESCOs) have been put forth as a potential means of overcoming this gap to energy-efficiency.

Well-functioning markets for ESCOs are therefore addressed as one of the key elements in the Energy Services Directive (ESD), a tool for the economy to move towards increased energy efficiency and sustainability. In other words, the development of the energy service market is of crucial importance if a Member State is to achieve the ambitious 2020-target.

The aim of this article is to analyse the market for energy services towards industrial small- and medium sized Enterprises (SMEs). Focus will be on the Swedish market, however general conclusions may be drawn from this example. A large part of the potential for energy services is not being implemented today - this is identified as the energy-service gap. The gap is explained by transaction cost economics; relatively high transaction costs for consulting ESCOs inhibit further market development. The ESCO market in Sweden is estimated, by the Swedish state, to still be immature but have potential for further development. A government report does not identify the market barriers on the energy service market as market failures. By introducing market development mechanisms (e.g. standardized contracts and an accreditation system) the state could decrease the transaction and thus the energy service gap. Reducing the energy-service gap could be a cost effective way of reducing the energy efficiency gap and reach the 2020-target.

Introduction

The EU:s 2020-targets for energy have set the course for Swedish energy policies. One of the stated objectives is to reduce the primary energy use with 20 % by 2020 from 2005's level. In the Swedish government bill for energy and climate the target for reduction of energy end-use is highlighted and a policy program to reach the objective is introduced. A stated ambition is to break the connection between economic growth and increased use of energy and resources. This shall be accomplished, given the Energy End-Use Efficiency and Energy Services Directive (ESD), through increased energy efficiency. (Government Bill, 2009)

Because of historically low energy prices, Swedish industry's electricity consumption is substantially higher than the average European industry consumption. Due to realisations of the negative external effects of energy production, scarce resources and the development of an integrated European electricity market, energy costs for Swedish industry has risen and are predicted to continue to rise further in the next years. (Johansson et al., 2007) This will have negative effects on the competitiveness of Swedish industries since their production costs will increase and may even become higher than their European counterparts (Trygg and Karlsson, 2005). Energy efficiency is therefore a no regret measure. It is a resource allocation that is not only good for saving energy and reducing the emissions of greenhouse gases but also beneficial from a pure economic point, both businesswise and socially. Reducing industrial energy utilization will decrease production costs and thus increase international competitiveness. (Thollander et al., 2009)

Even though cost effective, energy efficient, technical solutions are available they are not implemented to the extent that would be most both socially and commercially beneficial. Several studies point to the energy efficiency gap, which means that there is a difference between the level of investments in energy efficiency and the level that would be most commercially and socially beneficial. The energy efficiency gap is explained by market failures and market barriers to energy efficiency. (Jaffe and Stavins, 1994) One tool that has been mentioned to overcome many of the barriers is Energy Service Companies (ESCOs). Energy services are mentioned in the ESD as a cost effective way of improving the energy end-use by, e.g. auditing utilization and implementing energy efficient technologies. (EC, 2006) However the ESCO market in Sweden has not reached its full potential. The Swedish ESCOs are today mainly targeting the public sector; the industrial market segment is very limited. (Trygg et al., 2010; Thollander et al., 2010a)

The aim of this article is to explain, why the ESCO industry, that could help diminish market barriers to energy efficiency, is not reaching its full potential in Sweden. Conditions vary between different sectors but in this article the main focus will be on energy services for industrial small and medium sized enterprises (SMEs)[1]. These explanations will give indications to how public energy policy could be developed in order to increase ESCO market penetration. Even though the paper describes and analyzes the Swedish context, results may be generalizable beyond the Swedish ESCO market and Swedish industrial SMEs.

The energy efficiency gap

Numerous researches have illustrated the existence of an energy-efficiency gap. There is an untapped reservoir of cost –effective technologies that are not being implemented even though they could substantially improve the energy end-use in households, public buildings, institutions and private industries. What is an efficient investment is arguable; the technological potential is often greater than the economic potential since economic evaluations include discount rates and take opportunity cost into account. Neither perspective argues for that all energy efficient technologies available should be implemented, the hypothetical potential. There are technologies and energy efficient solutions that due to excessive costs or risks will not be implemented. Either way investment decisions where the benefits exceed the costs are being neglected. (DeCanio 1993; DeCanio 1998; Hirst and Brown, 1990; Jaffe and Stavins 1994; Weber, 1997)

To individual firms wasteful use of energy may not have a large impact on their profit, since the cost of energy is usually small relative to other expenditures and overall turnover. However, wasteful energy utilization is inefficient resource allocation that have huge macroeconomic repercussions, both socially (e.g. emissions) and economically (e.g. national competitiveness). The actors on the energy market are not leaving money on the table; the inefficiency can be explained by market failures and market barriers. (Brown, 2001)

MARKET BARRIERS

The neo-classic economic assumptions for a perfect market are: rational actors, no barriers to enter or exit the market, homogenous products, an infinite number of actors and sellers, perfect information, perfect factor mobility, constant returns to scale and costless transactions. If any of these criteria's does not hold a market failure exist. According to orthodox theory, a market failure is the only reason for public market intervention. Interventions are justified if feasible, low-cost policies are available to eliminate or compensate for a market failure. The benefit of the intervention must exceed the cost. The goal is to reach a theoretical social optimum. (Makowski and Ostroy, 2001)

Three market failures are usually used to explain inefficiencies on the energy market: externalities, imperfect information and asymmetric information (Sorrell et al. 2004).

Energy production often generates negative externalities which are not included in the cost of production, i.e. not internalized. This leads to the consumer price for energy being lower than the social cost of production, which in reality leads to an excessive demand and thus production. (Söderholm and Hammar 2005) However, since externalities, that are not already included in the price, do not explain inefficient investment decisions, it will not be further discussed in this article.

Neoclassical economics and market failures help explain part of the existence of an energy efficiency gap, but orthodox theory alone is insufficient to explain all obstacles. The theory of market barriers is a more comprehensive description, it is a synthesis of neo classical economics, behavioral economics and transaction cost economics (TCE). (Sorrell et al., 2004.

Market barriers is the umbrella under which all obstacles from these different theories are combined, all market and organizational failures that explain why investments with high rates of return are being neglected. Barrier models have been the widely accepted explanation for the energy efficiency gap, e.g. ESD (EC, 2006). A number of studies have investigated barriers to energy efficiency empirically (e.g. Schleich and Gruber, 2008). Many of the empirically spotted barriers may be categorized as market failures. The labeling of barriers varies in different studies but the overall content is usually congruent. They may be summarized as: *Risk, Imperfect information, Hidden cost, Access to capital, Split incentives* and *Bounded rationality.* (Sorrell et al., 2004 ; Rohdin and Thollander, 2006; Rohdin et al., 2007; Thollander et al., 2007).

NON-FAILURES

Sometimes explanations to why implementation of seemingly cost effective investments does not occur could be incorporated under market barriers but are actually neither market failures nor organizational failures. Often its explanations are non-failures, just organizations behaving rationally given risk and adjusted rate of return, taking all costs in to account. It is occasionally argued that discount rates for investments in energy efficiency are irrationally high, compared to other kinds of investments. (Jaffe and Stavins, 1994) But higher discount

1. This paper defines industrial SMEs as: industrial companies with 10–249 employees.

rates may be justified, from the individual organizations point of view, as rational reaction to calculated risk. Investments in energy efficiency are often incorporated into buildings or non-asset based. (Vine, 2005) This makes investments in energy efficiency difficult to resell. Energy efficiency is often not accounted for in the price of buildings or factories even though they affect the lifecycle cost. The second hand value of energy investments is therefore low and that makes these investments more risky than many other types of investments. (Sorrell, 2007)

Another economic opposition to the barrier models is the arguments against the barrier lack of information. Limited knowledge about energy in a small organization is usually not caused by information being unattainable. Information about energy usage, energy costs and energy saving potentials is available, but acquiring it is costly. It takes time and may require large efforts to find and digest relevant information if one is not already familiar with the issue and its units. In a small organization, whose energy costs only a small part of the overall turnover, this time and effort might be more efficiently spent elsewhere. (Shipley and Elliot, 2001; Sorrell et al., 2004)

Energy Services

Energy services have been put forth as one of the main tools to overcoming the energy efficiency gap; it is not a public policy program but a commercial market. ESCOs are often mentioned as an important instrument for a cost effective conversion of today's energy utilization, they can help to reduce many of the barriers to energy efficiency. (EC, 2006)

Energy service is a relatively new term. Before it was introduced the term *Demand Side Management* (DSM), originated from the U.S, was used. (e.g. Trygg and Karlsson, 2005). An energy service is a service that based on contractual arrangements aims to measurably improve energy efficiency. This may include implementation, auditing, maintenance and even financing energy efficiency projects. (Lindgren and Nilsson, 2010; Bergmasth and Strid, 2004)

An *ESCO* is a natural or legal person that provides energy services or other energy-improvement measures. The remuneration is usually performance based, at least according to strict definition. Performance and remuneration levels are decided in contractual arrangements, usually related to the energy savings generated from the service, guaranteed or shared savings. This performance based remuneration is included in agreements referred to as *energy performance contracts,* (EPCs). There are firms that offer energy services at a fixed fee. These consultants might not be included in the strict definition of ESCOs but still they are incorporated in some studies since excluding them would mean missing a large part of the energy efficiency suppliers. (Lindgren and Nilsson, 2010; Goldman et al., 2005)

Third party financing (TPF) is a service offered by some ESCOs. It is a service that provides capital to finance energy-efficiency measures (EC, 2006).

THE ECONOMICS OF ESCOS

ESCO's core business is energy management, their services requires them to stay well informed about technical and economical energy management solutions. Since their remuneration is performance based, it is in their interest to calculate all costs for the implementation of new solutions, even the hidden ones. By providing TPF they help finance the investments and often ESCOs share the risk of the project with the client since their remuneration depends on the project outcome. These are some of the arguments to why ESCOs help overcome market barriers to energy efficiency. (Vine, 2005; Lindgren and Nilsson 2010; Sorrell 2007)

Consulting ESCOs is a way for organizations to out-source energy management. The main objective for an organization to enter an energy service contract is to reduce the energy costs. Managing energy streams requires time and knowledge. Energy-intensive industries can afford to keep this competence in-house but smaller organizations whose core-competence is not related to energy, e.g. industrial SMEs, may lack the know-how needed to manage energy. (Shipley and Elliot, 2001) Often the energy managers of industrial SMEs have numerous responsibilities and therefore lack specific expertise in energy management (Shipley and Elliot, 2001). Since ESCOs specialize in energy savings they have the advantage of economies of scale, they use their knowledge multiple times which reduces the cost for knowledge assimilation per KWh. This advantage is, at least up to a certain point, inversely related to the size of the client organization. (Sorrell, 2007)

However the scale advantage depends on the nature of the service. Services can require either very specific or more general knowledge. The scale advantage is reduced the more specific knowledge that a project requires. If a consultant is to learn very specific systems and technologies for a project, solutions that cannot be applied in other settings or utilized in future business agreements the scale advantage is lost. Acquiring very specific knowledge becomes a sunk cost and makes the consultant vulnerable to the clients' demands, the ESCO then risks to become a price taker. The same reasoning applies to commodities and installations. Therefore ESCOs are often specialized in generic technologies[2] such as lighting systems and ventilation. More specific technologies such as machining and distillation are often more efficient to manage in-house. (Sorrell, 2007)

Through efficient management, ESCOs lower the energy costs for production, electricity bills, use of oil etc. To what extent the production costs can be reduced depend on the technical potential. But consulting an ESCO means transferring some, or all of the, responsibility and management of energy to an external part, the ESCO. This may generate increased transaction costs. Transaction costs include the resources that have to be used in order to carry out a market transaction. These are the costs for identifying a partner, negotiating contracts, monitoring and governing execution and performance etc. They include costs for personnel, consulting and legal costs. Transaction costs are consequences of the risk of opportunistic behavior of both parts and bounded rationality; they are not necessarily related to the size of the transaction. They depend on the actor's relations, incentives, legal structures and property rights. (Williamson 1985) The cost increase varies with the nature of the service and the scope and depth of the contract. The terms of ownership, implementation, financing, managing and remuneration needs to be negotiated and verified. The

2. For a more specific definition of generic processes in Swedish industrial SMEs, please see Thollander et al., 2007

performance of energy efficiency can be difficult to evaluate for some measures. Energy utilization may sometimes be hard to predict for measures, e.g. measures related to weather, occupancy and other varying factors. Therefore it is hard to with certainty establish the effects from implementing many of the available efficient measures and technologies. This means that clauses and terms must be carefully formulated in energy service contracts. (Sorrell, 2007; Goldman et al., 2005)

To summarize, Energy services will only be demanded if the reduction of production costs due to energy efficiency is estimated to be greater than the augmentation of transaction costs that will be generated from the consultation.

Energy efficiency in Sweden – focus on industrial SMEs

The initial interest for energy efficiency in Sweden was developed in the 1970s as a result of the oil crisis. In the 1980s the Swedish public voted in a referendum to face out the nuclear power production which even further increased the incentives to decrease energy end-use, but the focus was merely at costs savings rather than on energy saving targets. When the national electricity market was deregulated in 1996, energy efficiency was expected to become more prioritized but as electricity prices initially fell on the spot market, the attention to energy end-use efficiency decreased even further, energy efficiency was no longer a priority. (Lindgren and Nilsson 2010; EEC, 2008)

In recent years, as energy prices has elevated and are expected to continue to rise, the realization of the importance of energy efficiency has been revitalized in the industrial sector. Energy efficiency has become a priority to the EU and the Swedish government. The reduction of energy usage in industrial SMEs has been highlighted in governmental propositions and investigations. (e.g. Government Bill, 2009)

SWEDISH INDUSTRIAL SME'S ENERGY END-USE

The Swedish industrial sector answers for roughly one third of the nation's total energy use. In 2009 that meant 134 TWh. (SEA, 2010a) There are roughly 59,200 individual industries, 600 categorized as energy-intensive industries and the remaining 58,600 as non-intensive in Sweden. Three quarters of the industrial energy use goes to the energy-intensive sector (pulp and paper, iron and steel etc.) and the rest is used by the manufacturing, non-energy intensive industry, industries that usual fall in to the category of SMEs (SEA, 2010).

The specific energy end-use, in other words energy end-use per value added, is a measurement of how efficiently the energy is used. In the past 40 years the specific energy end-use has decreased with 66 %, in average 3 % per year for Swedish industry. In short term the industries energy utilization is decided by the scale of production. In 2009 production was low as a result of the international recession which led to a decreased use of energy, the production decreased by 18 % and the energy end-use by 11 %. The value added decreased more than the use of energy. Production decreased more than the energy-use because many energy flows are not related to scale of production. Support processes must run if any production is to be made; the same amount of lighting is necessary in a factory whether you produce ten or one hundred items in the same space. (SEA, 2010a)

The EU has concluded that the savings potential for energy efficiency in the European industrial sector is at least 25 %. Through the 2020 primary energy target it is implicitly stated that a 20 % increase is to be achieved. The potential for energy efficiency in the Swedish non-energy intensive industry has been differently evaluated. The estimations vary between 50 % (Trygg and Karlsson, 2005) and 15-20 %, 2-3 TWh/ - yrs (Thollander et al., 2007). The different valuations may depend on how potential is defined, Technologists' economic potential or the Economists' economic potential (Jaffe and Stavins, 1994). Either way, case studies have shown that, in average, almost 90 % of the cost efficient energy – investments in Swedish SMEs may be found among the generic/support processes (Thollander et al., 2007). It should be noted that individual firms may show large variations in regard to which types of measures that would be efficient investments. A future ex-post evaluation of the Swedish energy audit program will give even more accurate estimations of the potentials. Studies from Sweden and USA have found that the level of implementation (from the stated potential of energy efficiency) is between 40 and 50 % for industries that have conducted an energy audit. (Thollander et al., 2007; Corbett et al., 2009; Andersson and Newell, 2004)

THE SWEDISH ESCO MARKET

In the bill (2008/09:163) and in the investigation EEC (2008) the state has expressed the ambition to develop the markets for energy services. Energy services are estimated to have great potential to develop further, there are no financial or legal restrictions to energy services, but the market is judged as still being immature (Government bill, 2008, EEC, 2008).

There seems to be a consensus that the ESCO market has grown substantially in the past ten years as the interest for energy efficiency has augmented (EEC, 2008). By 2006, 12-15 ESCOs were identified in Sweden and their annual turnover was estimated to be 50 million Euros. Research in 2008 recognized 27 ESCOs in Sweden with revenue of more than 85 million Euros. However the numbers are not totally comparable since the first one did not cite any specific company names. (Lindgren and Nilsson, 2010) The ESCO operators can be categorized into four different sub-groups: product salesmen, consultants, energy producers and operating and maintenance companies. (EEC, 2008; Bergmasth and Strid, 2004) ESCOs in Sweden have primarily been targeting the public sector (EEC, 2008), a sector that utilize a large part of the Swedish energy but energy is not tied to their core business. The public sector often demand generic knowledge since most energy is used in buildings and offices. Also they have the advantage of being able to engage in large, long term projects. (Lindgren and Nilsson, 2010)

Energy-intensive industries are often aware of the potential cost savings form energy-efficiency. Energy-costs affect their core production process and they can therefore afford to keep the competence in-house and energy costs are included in life-cycle costs in investment decisions. Therefore it may not be cost effective for energy-intensive industries to outsource energy management. (Scheich and Gruber, 2008) Industrial SMEs is a sector that also, in total, uses a lot of energy, still individual firms often cannot afford to keep energy competence in-house since it is not a large part of their expenditures. Despite this there is only a limited market penetration for ESCOs among industrial SMEs in Sweden. (Thollander et al., 2010a)

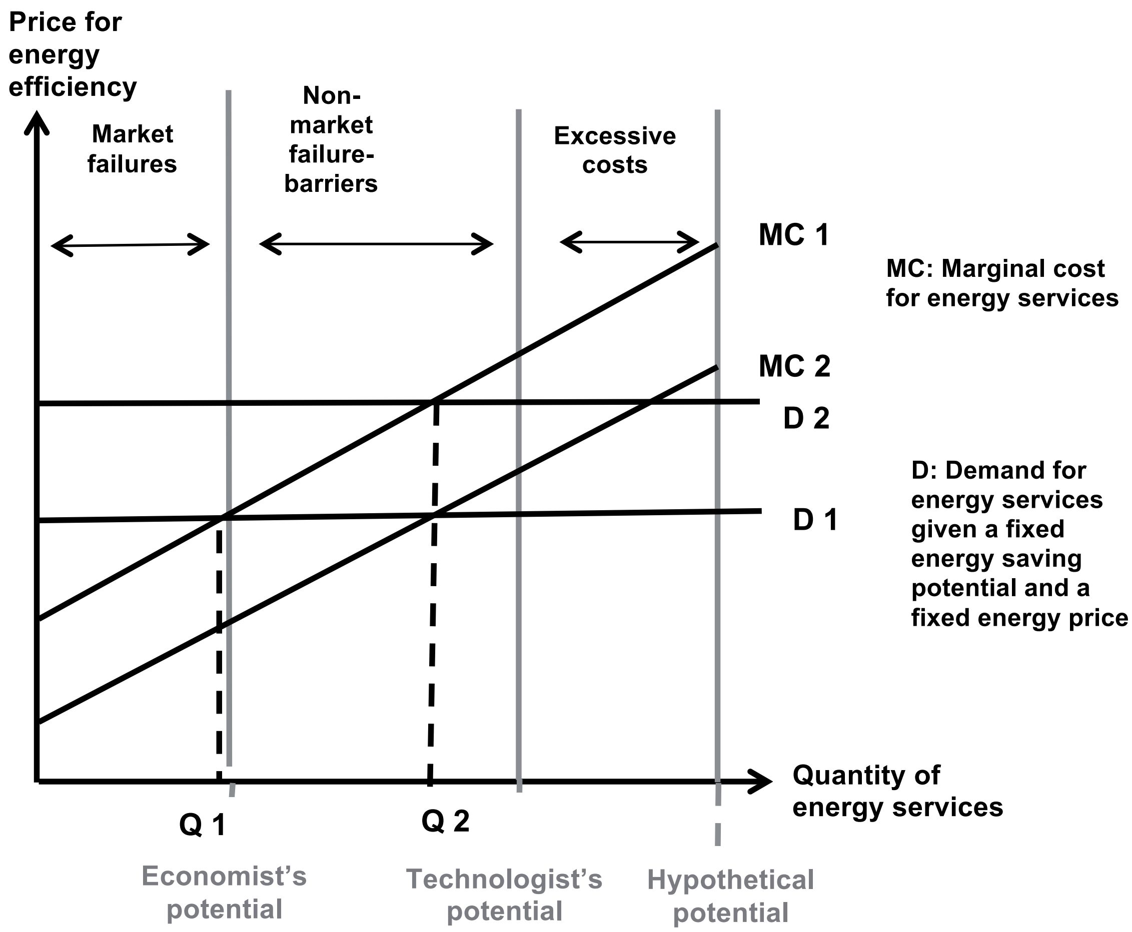

Figure 1: Illustration of energy-service gap.

PUBLIC POLICIES TOWARD ESCO MARKET IN SWEDEN

Since the Swedish state has concluded that no financial or legal obstacles exist on the energy service market, no changes to the legal framework are to be implemented. Instead the bill focuses on the importance of information. Through local energy- and climate councilors, networks and projects in different regions and sectors, the ambition is to raise awareness of energy efficiency and its potential. This is part of an energy-efficiency program that was introduced in 2010 and will continue until 2014 when its efforts will be evaluated. (Government bill, 2009)

In the ESD (EC, 2006) an accreditation system for ESCOs is advocated as well as standardized contracts for energy services. This has also been recommended in several studies of the European ESCO market (Vine, 2005; Bertoldi et al., 2005) However the Swedish state have concluded that there is no need for such interventions in Sweden since the market is well functioning without licenses or standardized contracts. (Ministry investigation, 2009)

To increase incentives for increased energy efficiency in industry the state has started a program to coordinate policies. As a part of this coordination the tax reliefs on energy that has been given to manufacturing industries, not included in the carbon trading program, will be reduced in two steps beginning in 2011. (Ministry investigation, 2009)

Economic subventions are generally not considered a cost-effective way of raising awareness since they are often used to finance investments in energy efficiency that would have been done even without them; there is a free rider problem. In the Program for energy efficiency (PFE), a project introduced in 2005 that offers tax release to energy intensive industries that implement energy efficiency measures, the free-rider effect was estimated to be up to 50 %. (Thollander and Doutzauer, 2010) Still one subvention to support energy efficiency was introduced 2010, a subvention for energy audits. The energy audit program will last till 2014 and the subvention helps finance energy audits by up to 50 %, to a maximum amount of 3,000 Euro. (SEA, 2010b) The aim is to increase energy efficiency by raising knowledge about energy-use and available energy efficiency measures in SMEs and non-energy-intensive industries. Since the program was recently introduced, no ex-post evaluation of the result or the cost effectiveness of the program has been performed yet. However, an ex-ante evaluation state that the program will deliver some 0.7-1.4 TWh/yrs in energy savings with a cost effectiveness of 200-400 kWh/EUR. (Thollander and Dotzauer, 2010)

The energy service gap – what does it mean?

To reach the ambitious 2020-primary energy savings target the energy efficiency gap must be reduced. Reducing the energy service gap would help reach that goal. Figure 1 is an attempt to graphically illustrate the energy service gap.

The illustration is a simplification of the energy service market based on a few assumptions. The y-axis measures the price for energy efficiency. The price for energy efficiency is assumed to depend on technological potential and its costs for implementing it. The demand for energy efficiency depends on how much the investments in energy efficiency will reduce the variable energy costs. In the graph the energy price is assumed to be fixed and given a certain level of technological potential and a fixed energy price, the demand curve is horizontal. If the price of energy rises, or technological improvements make energy efficiency less expensive, the demand for energy efficiency, and therefore energy services, will increase.

The x-axis measures the quantity of energy services being used; the quantity could be measured in total turnover for all energy service companies on a market. The marginal cost for energy services depends both on the technological costs and implementation costs as well as the transaction cost for performing the service. The illustration assumes that that the marginal cost rises with the quantity, this because the cheapest and easiest technologies "the low hanging fruits", will be implemented first. As the complexity rises, so does the costs.

The economists' potential for energy services is assumed to be the quantity that would be implemented if there were no market failures on the market for energy services, the technologist's potential is the potential that would be implemented if there were no market barriers to energy services and the hypothetical potential is if all hypothetical energy efficiency solutions were implemented by energy service companies. As technological progress is made the theoretical potentials will move to the right.

Without any public intervention the quantity of energy services consulted will be Q1, a level close to the economists' potential if the state's assumption that there are no market failures on the energy service market is correct. The politically desired level of energy services is represented by Q2, somewhere between the economists' potential and the technologists' potential. What is the optimal level for Q2 could be discussed but the energy efficiency gap is the difference between Q1 and Q2. There are two ways of attaining Q2: either the energy price has to rise and then the demand curve will shift upwards from D1 to D2, or the marginal cost for energy services must decrease from MC1 to MC2.

As stated earlier, energy prices have increased in recent years and due to technological progress it can be assumed that the cost for energy efficiency will decrease, but the energy service gap as well as the energy efficiency gap remains. If the 2020 target is to be accomplished, where the EU wants each member state to achieve an 80 % level of energy efficiency (20 % increased energy efficiency from the stated potential which is 25 %), public policy intervention is needed. Either the state can change the energy price by imposing energy taxes or it can reduce the costs for implementing energy efficiency. If energy services are estimated to be a cost efficient way to do this, its transaction costs must be reduced and market developing mechanisms must be introduced.

Concluding discussion

Reducing the primary energy-use by 20 % is one of the main objectives formulated in the EU:s 2020-targets. In order to manage this challenge the energy efficiency gap must be overcome. ESCOs have been raised as one way of reducing the energy-efficiency gap. The nature of their services helps overcome many of the stated barriers to energy efficiency. ESCOs main advantages lies in improving energy efficiency in generic technologies since it allows them an advantage of scale. However consulting an ESCO, as opposed to managing energy efficiency in-house, means increased transaction costs for negotiating, monitoring and formulating conditions for the performed service.

In Sweden ESCOs have mainly been targeting the public sector. This is a commercially attractive market since the public sector often demand help with generic technologies and can engage in large, long-term contracts. Since transaction costs are not merely related to the size of the investment, they become less significant in larger projects. The industrial SME sector also uses a large amount of energy and its main saving potential is in the support processes, i.e. generic technologies. Still ESCO's have not explored that segment of the market; this partly because the production gains from each individual contract would be too small in relation the transaction costs. This is the explanation for the existence of, what this paper has identified as, the energy-service gap.

The Swedish state has expressed hopes for the ESCO market to develop further. The ESCO market valued to have great potential and according to the state's evaluation there are no market failures. Therefore no financial or regulatory changes will be implemented. The main existing policy instruments to increase the demand for energy efficiency in industrial SMEs (or industries outside the carbon trading system) is informational tools to increase awareness of energy efficiency and somewhat raised energy costs by eliminating tax reliefs on energy.

One way of raising attention to energy efficiency is the program for subsidizing energy audits; targeting SMEs. Conducting an energy audit raises knowledge through increased information about energy usage and savings potentials. However being aware of potential savings is not the same as knowing how to achieve them. Technical knowledge is still needed, either to be attained by the enterprise or to be out-sourced, for the potentials to be implemented. For most industrial SMEs a cost effective energy management practice would be to outsource these services to an ESCO, if transaction costs were not as high.

Informational policy instruments raise awareness but finding information about energy is only one part of the transaction costs. Costs for negotiating, monitoring, evaluation, trusting, etc. still remains. An accreditation system and standardized contracts for energy services, which have been suggested in several studies and in the ESD, could decrease these transaction costs. If conditions for accreditation and contracts were formulated by authorities, each individual industrial SME would not have to spend as much time searching for a credible ESCO and negotiating contracts. Given the assumption that high transaction costs inhibit further ESCO market development, these policy measures would make industrial SMEs a commercially interesting market for ESCOs. By introducing these market development tools the Swedish state would decrease the costs for energy efficiency and reduce the energy efficiency- and the energy service gap in the industrial SME sector, a segment that consumes roughly eight percent of the total domestic energy end-usage. The specific energy end-use would permanently decrease. In short terms this would help Sweden reach the EU: s 2020 savings target but in the long term it would also have positive effects on the nation's international competitiveness.

References

Anderson, S.T., Newell, R.G., 2004. Information programs for technology adoption: the case of energy-efficiency audits. Resource and Energy Economics;26(1):27–50.

Bertoldi, P., Rezessy, S., Vine E., 2005, Energy service companies in European countries: Current status and

a strategy to foster their development, Energy Policy 34 (2006) 1818–1832

Brown, M.A., 2001. Market failures and barriers as a basis for clean energy policies. Energy Policy 29 (14): 1197-1207

Corbett, C., Muthulingam, S., Benartzi, S., Oppenheim, B., 2009. Adoption of profitable energy efficiency related process improvements in small and medium sized enterprises. In: Proceedings of the 5th European Conference on Economics and Management of Energy in Industry (ECEMEI-5).

DeCanio, S., 1993. Barriers within firms to energy efficient investments. Energy Policy 9 (1): 906-914.

DeCanio, S., 1998. The efficiency paradox: bureaucratic and organizational barriers to profitable energy-saving investments. Energy Policy 26 (5): 441-458.

EC (European Commission), 2006. Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC, Brussels.

EEC (Energy Efficiency Committee), 2008. Vägen till ett energieffektivare Sverige [The road to a more energy efficient Sweden]. SOU 2008:110. Stockholm. [in Swedish].

Government Bill, 2009. En sammanhållen energi- och klimatpolitik [An aggregated energy- and climate politic]. Prop. 2008/09:163. Stockholm. [in Swedish].

Goldman, CA., Hopper, NC., Osborn, JG., Review of US ESCO industry market trends: an empirical analysis of project data. Energy policy 33: 387-405

Hirst, E., Brown, M., A. 1990. Closing the efficiency gap: barriers to the efficient use of energy. Resources, Conservation and Recycling 3 (4): 267-281.

Jaffe, A. Stavins, R., 1994. The energy-efficiency gap. What does it mean? Energy Policy;22(10):804–10.

Johansson, B., Modig, G., Nilsson, L.J., 2007. Policy instruments and industrial responses - experiences from Sweden. In: Proceedings of the 2007 ECEEE summer study "Saving energy - just do it"; Panel 7:1413-21.

Lindgren Soroye. K and Nilsson, LJ., 2010. Building a business to close the efficiency gap: the Swedish ESCO Experience, Energy Efficiency 3: 237-256.

Makowski, L. Ostroy, J. M., 2001Perfect Competition and the Creativity of the Market, *Journal of Economic Literature:* 479–535

Ministry investigation, 2009, Effektivare skatter på klimat- och energiområdet [Efficient taxes on climat and energy]. Ds 2009:24). Stockholm. [in Swedish].

Ostertag, K., 1999. Transaction Costs of Raising Energy Efficiency. In: Proceedings of the 1999 IEA international Workshop on Technologies to Reduce Greenhouse gas Emissions: Engineering-Economic Analyses of Conserved Energy and Carbon.

Rohdin, P., Thollander, P., 2006. Barriers to and Driving Forces for Energy Efficiency in the Non-energy Intensive Manufacturing Industry in Sweden. Energy;31(12):1836-44.

Rohdin, P., Thollander, P., Solding, P., 2007. Barriers to and drivers for energy efficiency in the Swedish foundry industry. Energy Policy;35(1):672-77.

Sanstad and Howarth, 1994

SEA (Swedish Energy Agency), 2010a, Energiläget 2010 (Energy status 2010). Eskilstuna, Sweden [in Swedish].

SEA, 2010b. Swedish Energy Agency's homepage. Donwload January 10th, 2010 at: http://www.energimyndigheten.se/Foretag/Energieffektivisering-i-foretag/Stall-krav-vid-inkop/Aktuella-bidrag-och-stod/Ekonomiskt-stod-for-energikartlaggning/ [in Swedish].

Schleich, J., Gruber, E., 2008. Beyond case studies: Barriers to energy efficiency in commerce and the services sector. Energy Economics 30 (2): 449-464.

Shipley, A.M., Elliot, R.E., 2001 Energy Efficiency Programs for Small and Medium Sized industry. In: Proceedings of the 2001 ACEEE summer study on energy efficiency in industry, vol. 1, 183-196.

Sorrell, S., 2007, The economics of energy service contracts, Energy Policy 35 (1): 507-521

Sorrell S., O'Malley, E., Schleich, J., Scott, S., 2004. The Economics of Energy Efficiency - Barriers to Cost-Effective Investment, Edward Elgar, Cheltenham.

Sorrell, S., Schleich, J., Scott, S., O'Malley, E., Trace, F., Boede, E., Ostertag, K. Radgen, P., 2000, Reducing Barriers to Energy Efficiency in Public and Private Organizations. Retrieved October 8, 2007, from the SPRU's (Science and Technology Policy Research) Retrieved October 8, 2007, from: http://www.sussex. ac.uk/Units/spru /publications/reports/ barriers/final.html

Strid, M.,Bergmasth, M., 2004, Energitjänster på en avreglerad marknad För en effektivare energianvändning?, [Energy services on a derregulated market For a more efficient energy use?].Göteborg University. School of Business, Economics and Law, [in Swedish].

Söderholm P., Hammar, H, 2005, Kostnadseffektiva styrmedel i den svenska klimat- och energipolitiken?

Metodologiska frågeställningar och empiriska tillämpningar, [Cost efficient policies in Swedish climate and energy politics], Specialstudie Nr 8, Konjunkturinstitutet Stockholm [in Swedish].

Thollander, P., Dotzauer, E., 2010, An energy efficiency program for Swedish industrial small- and medium-sized enterprises. Journal of Cleaner Production (18)13: 1339-1346.

Thollander, P., Mardan, N., Karlsson, M., 2009. Optimisation as investment decision support in a Swedish medium-sized iron foundry - a move beyond traditional energy auditing. Applied Energy;86:433–40.

Thollander, P., Palm, J., Sakao, T., 2010a. Energy services in industry– an interdisciplinary approach with engineering- and social science aspects. In proceedings of the IPS2 Conference 2010, pages 51-56, Linköping, Sweden.

Thollander, P. Rohdin, P., Trygg, L., Karlsson, M.,Söderström, M., Moshfegh, B., 2010b, EU:s 2020-mål avseende primärenergi – en studie av effekterna för svensk industri, Linköping University

Thollander, P., Rohdin, P., Danestig, M., 2007. Energy policies for increased industrial energy efficiency: Evaluation of a local energy programme for manufacturing SMEs. Energy Policy;35(11):5774-83.

Trygg, L., Karlsson B., 2005. Industrial DSM in a deregulated European electricity market – a case study of 11 plants in Sweden. Energy Policy;33(11):1445-59.

Trygg, L, Thollander, P, Backlund, S, Olsson, L., 2010, Uthålliga energisystem i praktiken - implementering av energieffektivitet inom industrier, SEA, Linköping University

Vine, E., 2005 An international survey of the energy service company (ESCO) industry, Energy Policy 33 (2005) 691–704.

Williamson, OE, 1985. The Economic Institutions of capitalism. Free Press, New York

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