Task 45 Large Systems

ESCo models – General

Subject:	ESCo models – General description
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Download possible at:	http://task45.iea-shc.org/fact-sheets

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Introduction

ESCos are companies that provide a full range of energy services with repayment in generated savings. They offer a complete package, from design, finance and installation to operation, including maintenance and fuel supply.

Energy service companies (ESCos) could be a way to increase the uptake rate of large scale solar heat projects in larger buildings in the public and private sector.

Since the type of ESCo for delivering renewables is relatively rare, this approach is poorly understood. Thus, the project will analyze issues central to ESCo establishment, such as investment models, contracts and other relevant issues with regard to which information is limited and dispersed in the EU and worldwide. This work will also deepen our understanding of the hurdles which ESCos are faced with and will provide information on ways of overcoming such hurdles in practice.

At the moment, the perceived risks and uncertainty decrease the prospect for switching to sustainable methods of either generating or using renewable energy. It is envisaged that by managing these risks, the ESCos of this kind will bring about a change in the perceptions of potential recipients.

1 Initial Situation

1.1 Energy Service Contracting

The actual problem faced is that although solar thermal applications are technologically mature and economically advantageous in the long term, they have still little penetration in the European also world ESCo market, with respect to their potential. One of the main reasons is that end users (especially large ones) are still reluctant to face the high initial investment cost with collateral risk for the investor and doubtful for the reliability and durability of solar installations.

An Energy Service Company (ESCo) is a professional business, offering consumers through a wide range of energy services, the opportunity to reduce their energy consumption and the related costs. This wide range of energy services may include energy analysis and audits, energy management, project design and implementation, maintenance and operation, power generation and energy supply, monitoring and evaluation, facility and risk management.

In order for a company to differentiate itself from other companies that may provide some of the above mentioned energy services (e.g. consulting companies, energy suppliers, equipment manufacturers) and be characterized as an ESCo, it must have some additional features. These features are following:

- An ESCo guarantees energy savings and/or provision of the same level of energy service at the lower cost. A performance guarantee can take several forms. It can revolve around the actual flow of energy savings from a project, can stipulate that the energy savings will be sufficient to repay monthly debt service costs, or that the same level of energy service is provided for less money;
- The remuneration of an ESCo is directly tied to the energy savings achieved;

- An ESCo can finance, or assist in arranging financing for the operation of an energy system by providing a savings guarantee;
- An ESCo retains an on-going operational role in measuring and verifying the savings over the financing term.

ESCos are described in the Energy Service Directive (ESD) (2006/32/EC) together with energy performance contracting (EPC) and third party financing (TPF), as important instruments that can be used by EU Member States in order to achieve energy efficiency and reach the overall national indicative energy savings target of 9% (for the ninth year of application of the Directive).

ESD defines ESCo as a natural or legal person that delivers energy services and/or other energy efficiency improvement measures in a user's facility or premises, and accepts some degree of financial risk in so doing. The payment for the services delivered is based (either wholly or in part) on the achievement of energy efficiency improvements and on the meeting of the other agreed performance criteria.

In most of the cases the projects are energy supply contracts/ energy performance contracts (EPC) which can be characterized as ESCo projects.

1.2 Barriers

The main barriers liable for the weak development of ESCo projects cover a wide range of policy and administrative, financial, contractual and market barriers. Some of the barriers are commonly met among EU countries, while some others are related to the specific conditions in each country. In countries where the ESCo market is not much developed or is still in initial phase.

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Barriers	AT	BE	BG	CY	CZ	DK	EE	FI	FR	DE	GR	HU	IE	IT	LV	LT	LU	MT	NL	PL	PT	RO	SK	SI	ES	SE	UK	CR
Low awareness on the demand side	(•)		•	•		•	•	•	•	•	•	•		•	•	•	?	•	•	•								
Problems in implementing ESCo projects in the public sector	(•)		•	•			•		•	•	•	•		•	•	•	?	?		•								•
Financial institutions not willing to finance ESCo projects or provide bad lending practices	(•)		•	•	•	•	(•)				•	(•)		•	(•)	(•)	?	?	•									
Lack of standardized documents and procedures	(•)		•	•	•		•			(•)	•				•	•	?		•	•	•							
Lack of existing ESCo projects/expertise				•		•	•	•			•			•	•	•	?	•		•	•					•		•
Low energy prices			•					•	•			•					?	?		•				•		•		•
Lack of energy consumption data									?			•					?	?						•				

Table 1 Overview of the barriers that impede the development of ESCo projects in EU

•	Existing problem
(•)	Partially existing problem
?	No information available
	Problem does not exists

With the objective to overcome these barriers following activities have been conducted from “BioSolESCo” project and “ST-ESCo” project (European funded projects):

- Awareness raising activities including organization of workshops in partners’ countries, preparation and dissemination of promotional materials, presentation of projects results at conferences etc.;
- Overview of the European market including description and analysis of successful projects;
- Implementation of BioSolESCo projects in partners’ (22 EU countries, including residential buildings, industry, hotels, district heating projects etc., that have been thoroughly described;
- Financial spread sheet tool and contract templates for projects that will facilitate implementation of projects for potential clients and potential ESCo companies that are interested in realisation of ESCo projects involving biomass or solar energy.

Solar energy systems have reached a satisfactory technological maturity but commercial maturity varies a lot among different EU member states. Selected technology can provide highly efficient ESCo business services to different customers in the residential, public and industrial sectors in the EU. These opportunities for ESCo business are based on the solar potential for heating and preparation of domestic hot water. Proposed technology is selected because it has multiple advantages:

- Availability of the proposed ESCo business services;
- High efficiency and energy costs reduction;
- Availability of solar energy;
- Energy supply independence;
- Reduction of greenhouse gas emissions.

1.3 ESCo Opportunities

Public sector has been a trigger for the development of ESCo market in many countries and still remains one of the most important sectors for ESCo activities. Public sector is perceived as having safer clients that usually do not go out of business. On the other hand, public sector might be less motivated in energy efficiency projects than the private sector. Several barriers have been recognised that can impede implementation of ESCo projects in the public sector. Complicated public procurement procedures, e.g. separate calls for a project design and for project implementation, basing public procurement decision only on the best price without taking into account lifecycle costs i.e. associated energy savings during the lifetime of an ESCo project, or lack of clear rules how to treat ESCo projects within public budgeting.

Some examples of institutions from the public sector interesting for ESCo projects are:

Medical service institutions – Hospitals are interesting for ESCo business due to their continuous occupancy and energy consumption. Moreover, other medical institutions, such as public health centres or clinics, should be considered.

Institutions of higher education, schools and preschool institutions - Preschool institutions, such as kindergartens, differ from other institutions in this category because they have higher heating requirements and smaller capacities. Usually, they are not of interest for ESCo business as individual buildings. Institutions such as universities and schools have an interest in outsourcing heat supply due to lack of in-house know-how. Energy efficiency projects in this category can be standardized due to a similar and less diverse energy use. Standardization might enable implementation of similar projects in the cooperation with authorized institution, such as universities, cities, counties or a state.

Student homes, retirement homes – Buildings in this category are alike in their energy use to hospitals due to all-day occupancy and supporting facilities (kitchen, laundry room etc.). On the other hand, usually they are smaller energy consumers than hospitals and have a seasonal occupancy. Potential for standardization of these projects is high.

Buildings in the ownership of state/regional/local authorities – The principle is the same as for office buildings, with the possibility to make standardised contracts with one institution, e.g. state, county or a city.

Libraries, archives, museums, exhibit spaces - Projects in this category are interesting for ESCo business in the case of projects standardization and contracting of series of projects with one institution/client.

Industry sector has also very big potential in the fields of low temperature processes like metal industry, food processing industry, chemical industry, textile industry or capital goods industry, wherever goods are dried, cooked, baked, washed, pasteurised, sterilized, distilled, dyed or pressed, process heat is required. In the industrial sector ESCo projects are less frequent than in the public sector due to various reasons. Lack of motivation in the industry to use own capital funds for energy efficiency instead for capital improvements needed for the core business. This is especially the case in the non-energy intensive industry. Large companies that would be the most profitable clients for ESCos consider that they can implement and finance energy efficiency improvements themselves since they have sufficient funds and technical in-house expertise. They might not be willing to allow ESCos to check the core industrial processes because of confidentiality and specialized knowledge required to implement changes there. Moreover, time spans considered in many companies are shorter than the payback-periods for many ESCo projects and life-cycle costs are rarely taken into account. Finally, ESCos themselves often consider it more risky to invest in the private sector. On the other hand, this sector offers large opportunities for implementing ESCo measures.

Residential sector is the most problematic for ESCo activities, although saving potentials are significant and could be easily implemented, for various reasons. Low interests of housing companies due to high transaction costs and split incentives, saving potentials of a single project are usually small compared to the transaction costs and in the residential sector there are usually many private owners which increase the complexity of a project. Moreover, many energy efficiency projects in this sector are too small to attract the attention of large financial institutions. Due to these reasons there is a necessity for pooling smaller projects, e.g. buildings, into one larger project. Financial attractiveness for the ESCo and for the customer starts at 500m² collector area.

Potential ESCo projects in the residential sector include total outsourcing of energy supply, including measuring of an individual consumption and maintenance of a whole system. As the energy use in these objects is very similar, these projects can largely be standardized. Preconditions necessary for the implementation of an ESCo project can be set as minimum number of residents or housing size. Standardized models and scope of services should be developed which would make contracting simpler. Except energy supply, ESCo projects in this sector will include energy efficiency measures such as windows change, improved insulation of buildings etc. Initially, ESCo projects for an individual building do not look interesting for ESCo business, but it has to be taken into consideration that in the case of standardization and development of appropriate model, there is a large market for implementation of these projects. With the support of a local community it is possible to open a large market for ESCo projects.

Family houses in general do not offer a significant potential for ESCo projects, except in the case of family houses settlements that are connected to a district heating network or have a possibility to connect to the network.

Service sector, as a part of the private sector, might be more motivated in energy efficiency projects, especially in the case that clients' energy costs are significant. But, as clients from the private sector, they are perceived as more risky clients. Some potential clients from this sector are:

Hotels – They are significant consumers of energy offering high potentials for ESCo projects. Their suitability for an ESCo project involving solar energy will depend on their seasonal occupancy and location i.e. climatic conditions.

Shopping centres, stores, restaurants, bars - This category includes diverse objects with different size. Smallest and simplest are in the same time the most numerous one, while large shopping centres are individual, more complex energy systems.

Office buildings - Large office buildings offer numerous possibilities for implementation of ESCo projects. These projects can be standardized and implemented many times.

Banks and similar institutions - These are small but numerous energy consumers. These projects can be standardized and implemented many times. Management of energy use for larger number of buildings owned by the same client could be very interesting for an ESCo.

Buildings in the transportation sector - These include terminals, airports, public garages etc. Terminals have some potential, while garages, usually, do not offer larger potential for ESCo business. Airports are distinctive cases, as these are complex systems with large energy consumption. There is an important role in preliminary energy audits and defining suitable ESCo measures in this category.

Commercial sport halls – Usually these are smaller objects with higher occupancy and more continuous energy consumption than public sport halls.

2 Marketing Aspects

Strategies that ESCos should adapt for market penetration are described in this section. The goal to elaborate a marketing strategy to convince the end user to install solar plants in each country. As for each marketing strategy the framework conditions play a major role, the strategy has to fit in the circumstances which vary from country to country. The strategy described here is based on the conditions which prevail in Austria and does not focus on country specific circumstances.

Based on this the strategy to reach the target group follows four steps which are:

- Identification of target group
- Addressing the potential customer
- Concrete information about a contracting project
- Concrete project acquisition and project development / support by local energy
- Agency or independent consultant

2.1 Analysis of strategies for relevant decision-makers of the identified target groups

Barriers for the increased application of solar thermal plants are:

- "New technology" for the planners and architects (missing know-how)

- Higher investment costs for the costumer/company
- More complex and expensive planning
- Not enough information for planners, architects, housing companies about subsidies, solar systems/technologies, pilot projects
- Costumers / companies don't believe that the simulated solar results will be realised
- Aesthetic and system – building integration issues
- System and installation quality

Arguments frequently used against the implementation of ESCo projects:

- Long contract period
- Payment for outsourcing the energy supply
- Solar energy price too high (compared with up to now used energy source)
- Confidence that the fossil energy prices will continue to be favourable

Therefore the strategy should be designed to overcome barriers which often prevail. There are a lot of reasons for the customer which argue for the implementation of ESCOs e.g.:

- No or very low investment cost for the customer, minimizes the financial risk
- Guaranteed development of solar energy price, advantage compared to other energy sources
- Complete energy service package provided by one company, no implication of the customer with technical issues
- Guarantee of state-of-the-art technical and economic solution, maximum solar output (is in the ESCOs interest)
- No problems with respect to operation and maintenance of the system
- Take advantage of grants
- Constant framework conditions for the establishment of a fruitful business
- Prestige (standing out from one's competitors, a positive attitude towards new technologies)
- Marketing strategies (to also sell ecological advantages, to sell engineering)

The following measures are necessary and recommended to improve the current situation (to overcome the above mentioned barriers):

- More and specific information for the planners, architects, customers / companies and installation firms (e.g. folders, marketing campaigns, ...)
- Workshops and training for installation companies, planners
- Guarantees for the costumer
- Voluntary agreements
- Excursions to already realised solar projects
- Create new synergies with actors already involved, for better dissemination of information

3 Financial, Contractual and Legal Aspects

One of the crucial parameters for the development of the ESCo market is the project financing. In order to implement ESCo projects there should be a party able and willing to finance these projects.

In some countries, where large ESCos exists (e.g. FR) the financing of the projects is done by the company's own capital. For example ESCos in France are large companies that have the financial means to finance projects if necessary, thus the role of banks is limited [6, 13, 17]. In other countries where there is either no ESCo market developed yet, or there are only small ESCos active in the market, without the ability to finance large projects, it is necessary to have financial institutions willing to finance the projects. Unfortunately, in some of the countries (e.g. GR) the financial institutions are not familiar with the concept of ESCo projects, thus they provide conservative lending practices, resulting this way in the lack of commercially viable project financing. While in other countries, like in Hungary, third party financing from banks is not an issue, as the banks are willing to finance performance contracts, at least to established actors in the 14 field of energy services. TPF is not very common in Sweden, as the majority of the clients are public bodies, which can provide the funding from their own sources.

In general, contracting schemes with reliable long-term backflow of funds are attractive for financial institutions, especially when the client belongs to the public sector. However, banks haveto consider a number of risks [15]:

- Not only the client's solvency poses a risk (not in the public sector); the contractor's reliability has to be considered as well. These risks are minimized when contractors can refer to a large number of contracts and the risks are divided;
- The viability of contracts has to be assessed; this can be difficult since the related contracts are very complicated; issues concerning price adjustment, ownership structures, distribution of duties and risks to the contract partners have to be solved; banks should be included in the contract design at an early stage in order to prevent problems;
- Liability, warranty and insurance

Banks do not often have the know-how to assess the technical setup of installations and especially energy saving potentials and technical risks are difficult to estimate.

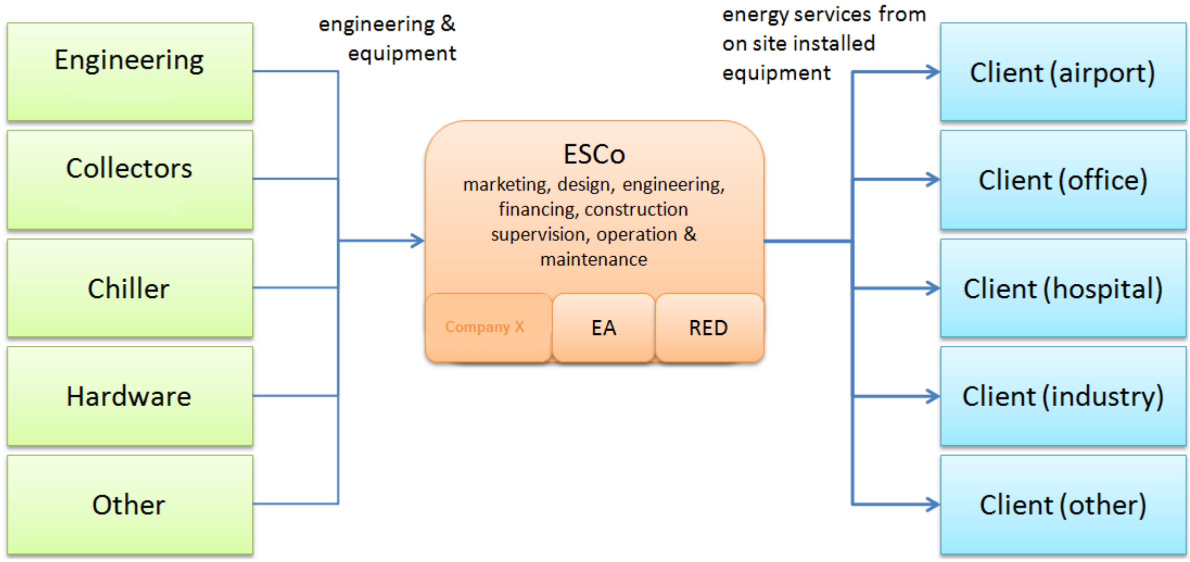
In many countries financial schemes and mechanisms to support projects in the fields of energy efficiency and renewable energy sources have been developed. These financial schemes are most of the times in the form of subsidies or low-interest loans. Many of the support mechanisms focus on energy efficiency while others include also renewables.

3.1 Business Models

In general there are no fixed rules for agreements between the customer and the ESCo for what concerns the financial schemes, i.e. the payback of the investment (from ESCo's point of view) or the payment of the energy (from customer's point of view).

The choice of financial scheme largely depends on the financial reputation of the ESCo and on the conditions it can get at a financing institution; these conditions might vary (in the range of 100%) and depend on personal contacts with the bank.

Figure 1 shows the main components and working scheme of the ESCo's theoretically process:



Anyway, there are three different schemes for billing the solar energy between the customer and the ESCO. Most schemes which are implemented in real projects follow one of these schemes or a mix of these:

- **Energy price only**: the customer pays a certain energy price per kWh of solar thermal energy. The energy is usually billed once every month or once every two months. This means that the payback for the ESCo works only by means of the energy sold, and a big share of the customer's payments arrive in summertime. Usually, for domestic hot water the ESCo and the customer agree for a different summer and winter price (summer price higher, as conventional boiler systems have lower efficiency in summertime, thus specific end energy prices are higher). Usually for space heating the energy price is every month the same. This scheme is generally favourable for the customer. Monthly amount charged to customer: MA = SEm × SEPh
- Energy price and basic price: Additionally to the cost per kWh, the customer is also charged a basic monthly price which he is asked to pay regardless of the energy delivered. In return, the energy price for the kWh of solar energy is lower. This model provides some more security for the ESCo as it will get the monthly payments in any case. Moreover, the ESCo gets some money out of the system also in wintertime, when the earnings based on the solar energy output are close to zero. Monthly amount charged to customer: MA = BP + SEm × SEPl
- Energy price and connection fee: Similar to the installation fees which a customer is charged for being connected to a district heating net, in this scheme the customer pays (some share or 100% of) the installation cost of the system. This amount of money is often denominated a connection fee and may be calculated based on the kWh delivered per year or based on the installed collector area and system design. In return, the energy price for the customer is reduced, so the ESCo needs to perform a very thorough economic feasibility calculation. Monthly amount charged to customer: MA = SEm × SEPl. Connection fee has to be paid once at the delivery of the solar plant.

Independently of the model chosen, a certain amount of money (penalty fee) should be agreed upon in the case the customer wants to exit the energy supply contract before the agreed validity period of the contract.

In the financial negotiations with the customer, if the ESCo decides to foster a certain model, the ESCo should also keep in mind the technical background of the project:

there is none financial scheme which is best suited for all types of projects. E.g. if the ESCo trusts the customer (both technical preconditions and financial situation) than it may opt for lowering the basic price and instead go for a somewhat higher energy price. On the contrary, if the customer seems not very trustworthy, then the basic price should tried to be kept high as this – together with the option of a bank guarantee – assures the payback of the plant to some extent. Of course, projects with a too high risk should simply be declined by the ESCo!

MA = montly amount paid by customer and earned by ESCo

SEm = solar energy in MWh in current month

SEP = solar energy price per MWh solar energy (high)

BP = basic price paid by customer every month

SEP = solar energy price per MWh solar energy (low)

The existing ESCo business models have a several application in the EU and in the type of small, large scale, domestic, industrial. The type of contracts used in each country for implementing ESCo projects ranges from the most well-known schemes like Energy performance contracting (EPC), Third-party financing (TPF) and Heating delivery contracting (HDC).

Energy performance contracting (EPC): a contractual arrangement between the beneficiary and the an ESCo of an energy efficiency improvement measures, where investments in that measures are paid for in relation to a contractually agreed level of energy efficiency improvement;

Third-party financing (TPF): a contractual arrangement involving a third party — in addition to the energy supplier and the beneficiary of the energy efficiency improvement measure — that provides the capital for that measure and charges the beneficiary a fee equivalent to a part of the energy savings achieved as a result of the energy efficiency improvement measure. That third party may or may not be an ESCo;

Heating delivery contracting (HDC): In this case, the contractor plans, finances and constructs new heat production facilities or takes over an existing heating infrastructure. During the contract duration the contractor is responsible for plant operation, maintenance and attendance. He buys primary energy and sells heat to the customer. Energy savings of course are part of these projects since new or refurbished boilers work more efficiently. The customer usually pays a basic price that covers the contractor’s investment costs, including loan repayment. The basic price also has a component covering plant maintenance. This cost component is flexible regarding the increase of average salaries. The second part of the monthly payment depends on energy consumption.

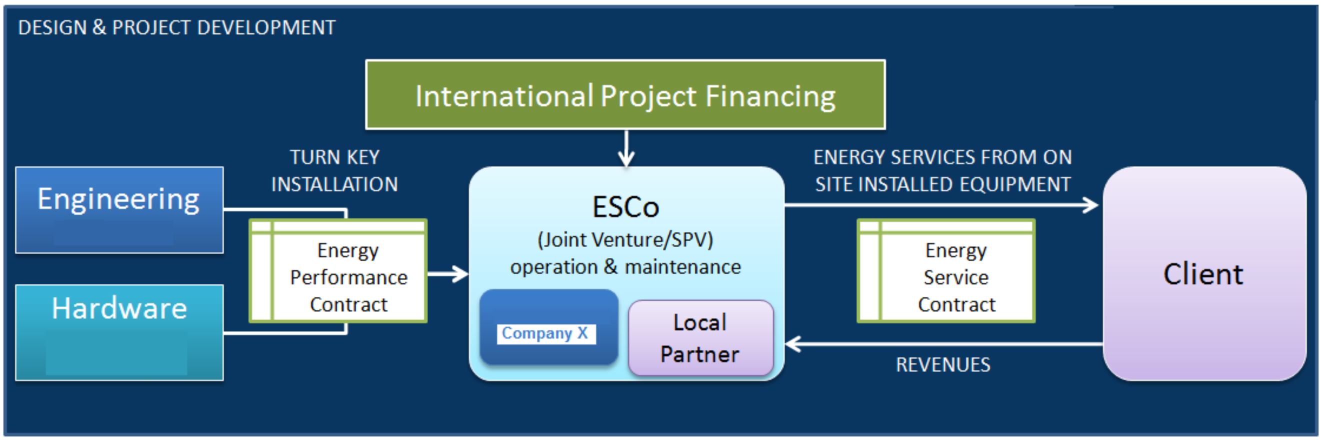


Figure 2 The principal Energy performance contracting (EPC)

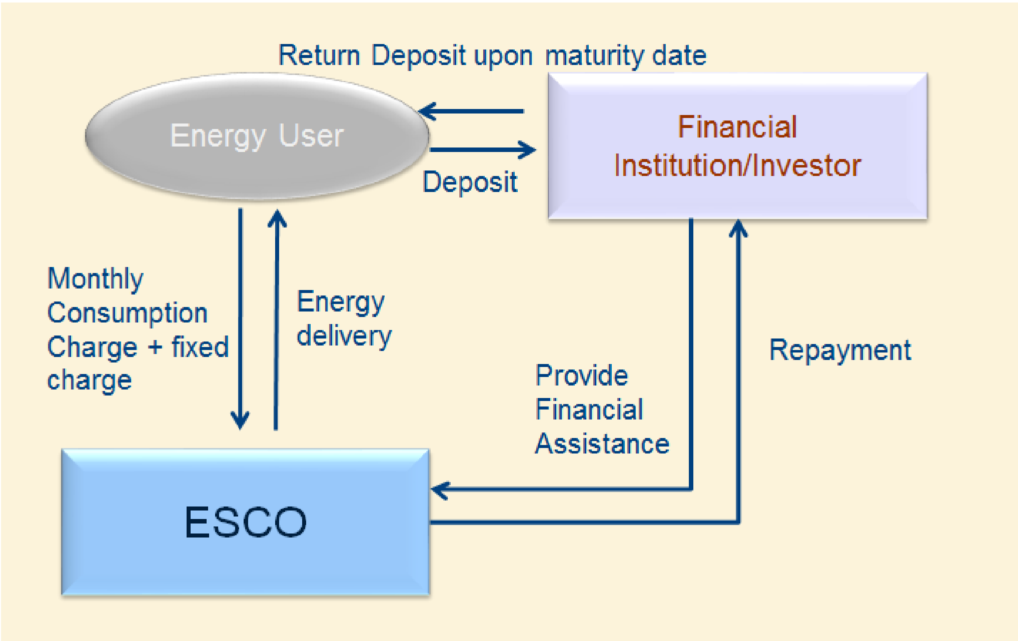


Figure 3 TPF Third party finance scheme

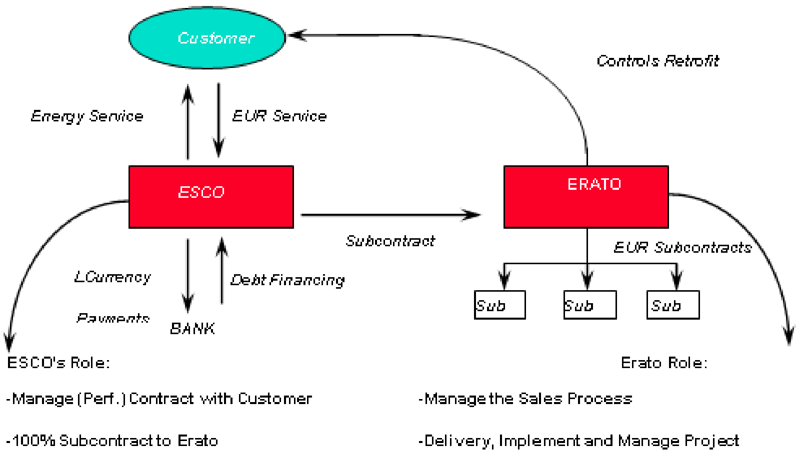


Figure 4. The principal heating delivery contracting (HDC) scheme

3.2 Conditions and guarantees

There are certain preconditions usually included in the energy service contract (see respective section) which have the task of guaranteeing favourable conditions for both contracting parties. The detailed scope of these conditions depends on the technical characteristics of the project as well as on the specific situation of the customer and of the ESCO (financial questions). Technical and financial prerequisites and conditions fixed in the contract are closely related and are crucial for the economic feasibility of a solar thermal ESCO project. This is going to be even more important in future when the size of an average large-scale solar thermal system is going to rise, and therefore economical questions such as the return-on-investment and the cash flow situation of the investment (i.e. the solar plant itself) become much more important than they are today.

3.2.1 Assesment Tools

For quick assessment of the potential of ESCo projects 2 Tools have been developed in the European funded projects ST-Escos and BioSolEsco:

http://www.cres.gr/st-escos/tool.htm

http://www.biosolesco.org/financial_tool.html

3.2.2 Technical Guarantees

System operation guarantee of the ESCO: In most cases, the customers demand the ESCO to guarantee for the correct operation of the system; this includes the solar plant behavior in the case of stagnation. Usually, the compliance with the respective security standards suffices this demand.

Energy supply guarantee: Most customers demand a guaranteed energy output (kWh/m²*year or MWh/year for the whole plant) from the solar plant to see that the system will suffice their energy needs and also to provide for an appropriate backup system. If the ESCo not only installs and operates a solar thermal plant but is responsible for the whole energy service of the customer, a guarantee for the energy supply for the whole year must be given. E.g., the ESCo could also install and operate (or buy the energy from) a biomass boiler or buy energy from a district heating net, and then sell this energy to the customer thus providing for the total customer's energy need.

It is important for the ESCo to find the correct restrictions to an energy supply guarantee in the case the customer does not fulfil the agreed technical specifications.

Most of the problems with low energy output are due to

- bad system design (find a solar energy system supplier with more experience)
- less energy use by the customer than stated in the contract (agree for a minimum
- energy consumption and include penalty payments)
- basic technical conditions not as agreed, e.g. return temperature to solar plant too high (this is a delicate issue; must be solved individually with each customer). It is important for the ESCo to rely on temperature levels and energy consumption numbers which really can be achieved; otherwise the financial risk can be very high.

Most of the time, the calculation of the energy output values by aids of a simulation program or the proof of the provided numbers by some test certificate do not satisfy the customer's demand of a guaranteed energy output for a specific plant site!

Instead, most customers want to see the respective numbers of similar plants built by the same system supplier and run by the ESCo in a reference list.

3.2.3 Financial guarantees

In general, the bank or financing institution has the right to take over the solar system if the ESCo goes bankrupt. This is a crucial aspect at negotiating about the financing plan of the solar system with the bank.

Bank guarantees: Bank guarantees are an important tool for a larger ESCo which has already gathered a vast experience with the contracting, the operation, the installation and the maintenance of large-scale solar thermal systems. A bank guarantee allows such an ESCo to head for projects with a higher risk (e.g. very large projects with large investment amounts to be financed in advance or projects with a more difficult technical background, or projects abroad where many conditions may be different).

The bank guarantee is some sort of contingent liability which can be used in the case the customer can not pay the energy bills on which the ESCo bases its back payment to the bank. In such a case the bank guarantee comes to effect and the ESCo gets the money from the bank. The cost of a bank guarantee must be individually fixed between the ESCo and the bank and depends strongly on the customer's financial situation.

In some cases, it is even possible to get some sort of bank guarantee from public administration or federal banking institutions set up for this special aim. E.g. in Austria, the ÖKB (Österreichische Kontrollbank) provides bank guarantees for projects abroad, but they are usually interested in very large projects only (investment > 1 mill. Euro).

3.2.4 Financial Institutions

In general financing institutions expect that ST-ESCo financing should have a pay back time below 5 years. Loan contracts for more than 10 years are especially with large Austrian Bank institutions not realizable. Bank institutions have problems because of their rigid hierarchy so therefore access via local, smaller banks is probably more successful. The attitude of a bank towards solar ESCos seems to be largely depending on the internal structure and the personal experience of the decision makers with renewable energy projects. Investors groups are of interest when realizing a close cooperation with companies that work in the environmental or ecological sector.

Past successful implementations of solar thermal ESCo plants have shown that contact with financial institutes which shall carry out the financing of the investment cost is a crucial aspect. In all successful ST-ESCo examples in Austria, the contact to small, local financial institutions with flat command structures have shown to be the most promising way. Personal contacts to the upper management of a small bank with the appropriate person being positive about the project, has turned out to be a good approach.

In the case that solar thermal projects shall be implemented internationally, it probably makes more sense to start at the same level where the first third-party-financed solar thermal projects started, i.e. at small, local banks with good contacts to the bank director. In order to minimize the financial risk for the contractor, a suitable bank must also be chosen for the bank guarantee for the solar plant. This bank guarantee becomes effective in case the customer is unable to pay the TPF fee to the contractor.

3.2.5 Insurance Schemes

Following a list of the points that an insurance scheme (under an ST-ESCos agreement) has to cover:

1. Insurance of equipment against the following:

a. Extreme weather conditions.

For each of those conditions, precise specifications (extreme limits) have to be defined; when the weather conditions exceed the specifications set then the insurance will cover the damages. (Example: the ESCo sets the extreme limit of external ambient temperature -25ºC that the solar field can stand without freezing problems.

The insurance will cover the cost for all damages caused by a certified extreme temperature hat is lower than minus 25ºC). The certification body has to be defined in the insurance scheme. The most important extreme conditions for solar thermal plants are the following:

- Hail for collectors’ glasses
- Thunder for the control unit (difficult to set specifications in this case)
- Extremely strong wind that may draw away some collectors
- Extreme freezing conditions that may damage tubes in the collectors or the external hydraulic circuit
- Lightning
- Flood

b. Thievery or vandalism under some conditions (e.g. the access on the collectors’ field and the other components of the solar plant has to be well defined).

c. Fire or other well defined causes originated from the building or from surrounding buildings or objects.

2. Insurance of the investments done and the economic obligations stated in the contracts.

3. The insurance scheme should have a clear reference to the fact that there are two different owners involved in the ESCo agreement: a) the owner of the solar plant (ST-ESCo) and b) the owner of the building (place) were the solar plant is installed (the End-User).

Aspects that insurances cannot cover are the following:

- Damages that may occur due to casual external factors (e.g. animals that may damage the pipes' insulation or collector sensors).
- Generally speaking, casual events that are not well defied in the insurance scheme cannot be covered.
- Damages that the solar plant may cause to the building or people (e.g. damage on the roof due to leakage, injury against people in case of a falling solar system component etc.). All these aspects should be subject of another scheme that should be a "Third party Liability" scheme. (note: In Italy this is a must – always requested)

3.3 Measurement and Verification (M&V)

ESCos operate and maintain solar plants on longer periods and bill the produced solar heat to the customer. This role of the ST-ESCo implies particular objectives and requirements on the measurement and verification procedure applied to the solar heating systems.

The specific objectives of M&V are:

1. cost effective control of the plant

2. monitoring of an optimal plant operation

3. measurement of the heat to be billed to the customer

4. rapid fault detection

Corresponding requirements are

ad 1. remote availability of data of the system status and remote access to the

controller parameters

ad 2. e.g. daily measurement of the crucial quantities and comparison with expected

values

ad 3. certified heat meters with sufficient accuracy (see clause 2.4.2)

ad 4. fault analysis routines incorporated in the controller software

3.3.1 Controls and Monitoring

The control of solar heating plants is in general not complicated; however, several particularities regarding their control strategies have to be taken into account and obeyed in order to safeguard an optimal operation.

In principle two type of controllers can be used for solar heating plants:

- freely programmable mainframe controllers
- freely programmable solar controllers

Mainframe controllers offer the maximum freedom regarding their configuration and extension to data acquisition, processing and remote access. However, in many cases the choice of this type of controller led to practical operation problems, since the solar specific particularities were not satisfactorily programmed due to the lack of expert knowledge of the programming personnel.

Freely programmable solar controllers, produced by specialised manufacturers, offer pre-configured routines for these particularities and thus ensure a more robust operation. Several commercial products are available and extendable for data acquisition, processing and remote access.

3.3.2 Measurement techniques

- **Solar radiation:** Solar radiation is the basic energy input to the solar heating system and needs to be measured, in order to assess the heat output of the system. Radiation data are mainly used for daily, monthly or yearly system yield verifications, therefore no high-level measurements are needed. In most cases, only total radiation is measured (no separation of beam and diffuse radiation).Two sensor types are available on the market:
    - PV sensors, which due to their wavelength-dependent sensitivity have a rather limited accuracy
    - Pyranometers working more accurate based on a thermal effect. The accuracy classes are defined in ISO 9060 resulting in accuracies for the measured daily radiation of approximately ±3% for secondary standard, ±5 % for first class instruments and ±10 % for second class instruments. Pyranometers are sensitive against sensor pollution and have to be cleaned at regular intervals, depending on the actual and local pollution conditions.

An alternative to radiation measurements can be data obtained from satellite pictures. These data can show high deviations for instantaneous measurements but produce fairly good agreements on a monthly base.

- **Temperature Measurement:** The availability of temperature measurements at several locations within the system are useful for detecting possible faults and error sources (e.g. too high return temperatures of the collector field circuit). Most commonly used temperature sensors are Platinum-resistance-thermometers of the PT 100, PT 500 or the PT 1000 class. Basic recommendations for the installation of temperature sensors are:
    - Sensors must be in good thermal contact with the measuring medium (well insulated immersion sensors rather than clamp-on)
    - Sensors and cables installed in the collector circuit should be resistant up to 200 °C
    - 2-wire-cables are sufficient for control purposes. For measuring purposes 4-wirecables are recommended, in order to eliminate cable length influence.
- **Heat Metering:** Heat meters need to be calibrated to the local conditions (like every temperature sensor in the solar plant) and then need to be re-calibrated by the manufacturer about once every five years. The heat meters should be M-Bus-capable; this system connects the heat meters with the solar plant control and is a defined protocol for reading the solar energy yield.
- **Pump and valve status monitoring**: In case time series are taken from radiation and temperature data, it is recommended to also monitor the status of pumps and valves in order to identify any control strategy mismatch.

- **Online functioning verification:** Most controllers have the feature for an online plant functioning verification, i.e. relevant temperatures and statuses are continuously verified against functioning criteria implemented in the controller software. In case one of the criteria is not matched a warning is sent to the plant operator, in order to immediately recognize any operation problem. Examples for such criteria are:
  - Significant irradiance, but the pump is deactivated
  - Night time, but the pump is activated or the collector is warm
  - The pump is activated and the temperature difference between flow and return pipe of the collector circuit are excessive
  - The pump is activated and the temperature difference between collector and collector circuit flow pipe are excessive
  - The system pressure is low (if measured)
- **Daily plant yield verification:** A plot of the daily plant yield versus the daily radiation allows for a simple verification of the plant efficiency. During regular operation periods, measuring points should grow up close to a linear dependency of these two quantities. Reasons for low measured plant yield can be either days with significantly lower heat loads than expected or plant operation problems. In both cases the ESCo should be notified in order to verify the cause.

Programmes like TSOL or TRNSYS allow to produce more refined correlations between the expected system yield, the radiation, the load and other relevant quantities. Such correlation allow to better assess the actual efficiency of solar heating systems. This kind of verification can be automated and implemented into the controller software.

3.4 Automated Malfunction Control

An Austrian ESCo (S,O.L.I.D.) provides in an automated operational surveillance of their solar thermal installations. http://www.ip-solar.com/

The software is able to correspond on different types of controlling unit and is not dependent on special measuring equipment.

Features:

- quality assurance and energy output monitoring of solar thermal installations
- sends automatic notifications to the plant operator in case of a malfunction (SMS, email)
- standardized monitoring at low ongoing cost
- detailed solar plant evaluations on an online platform (under development)
- the scientific and technical basis are currently developed in an R&D project

3.5 Legal Background

A general review of the ESCo markets of the European Member States demonstrates that diversity exists among the countries in what concerns the ESCo market development, structure and regulations. In some countries (e.g. UK, IE, GR, FI. PT) at least up until now, there is no particular legal format for ESCos, and the constitution can be any of the recognised formats in the country’s law. Also there are no particular rules relating to the provision of private finance of ESCos, other than those that apply to borrowing and contracts generally. For example in UK and Ireland, where this case applies, it is suggested that Private Limited Company would be the most appropriate vehicle for most ESCos as it is the most flexible.

With the Energy Service Directive – ESD (2006/32/EC), which was deposited upon all EU member states in 2006, the lack of specific legislative framework of the energy service market is expected to change, and this way the operation of ESCos will be clarified and the energy service market will be helped to move forward and develop. The ESD, which should have been transposed into national legislation by all member states by May 2008, aims to a cost effective improvement of energy efficiency in end-use by indicating target values, removal of market barriers, and stimulation of the energy service market. As reported in December 2008 [16] 7 member states had communicated full transposition of the ESD into national legislation, 11 member states had communicated partial transposition while 9 member states had not communicated at all.

In some of the countries where the energy service market is already developed the terms ESCos and energy services are not necessarily used. For example in France the terms ”energy service” and “Energy Service Company”, which are common in Europe, appeared in the country only in late 1990s thanks to the liberalization of energy markets and due to the development of the Energy Service Directive and the subsequent debates [7]. Also in Germany the term ESCo is hardly used. Instead, this business model is referred to as Contracting. In order to prevent confusion concerning the terms describing contracting, the DIN 8930-5 “Contracting” (2003) defines the basic terms, several alternative contracting schemes, service components, pricing for services, application areas and the legal background.

One of the most important legislative restrictions that impeded the ESCo activity in the public sector in many of the European Member States was the fact that operation and particularly purchase of equipment, as well as provision of services including energy services in the public sector was not allowed to be designated to private entities. It has long been claimed by ESCos that the engagement of the private sector to provide complex solutions for the public sector would be beneficial and could deliver innovative solutions. This issue has been partly solved almost in all the EU countries (e.g. FR, IT, DE, U.K, IE, GR, SI, SP, PT, CY, RO, SK) and Croatia when legislation on Public Private Partnerships (PPPs) has been established. Of course the level of PPPs adoption and the sectors these agreements can cover differentiate a lot among member states. PPP is a sort of “umbrella notion” covering a broad range of agreements between public institutions and the private sector aimed at operating public infrastructures or delivering public services [19]. In what concerns the implementation of ESCo projects in the public sector, under these special and formal agreements, multi-year concession contracting regarding the installation, operation and maintenance of leased/outsourced energy efficient equipment in public buildings can theoretically be realized. The PPPs allow the public sector to pay the private company’s remuneration periodically during the project, and allows that payment being based on performance indicators previously set out in the contract (instead of being purely revenue based). In order to further increase the effectiveness of this regulation, public accounting rules should also be revised and the separation of operation and investment budgets should be overcome in case of ESCo projects, where it is very important that the savings in operation budgets could be used as a levy for investments in energy efficiency. Moreover, public procurement rules should be revised to allow including energy performance criteria.

In the Baltic countries (Latvia, Estonia, Lithuania) unstable and not well defined regulatory frameworks as well as unfavourable procurement procedures contribute to slowing the initialisation of market growth. In Poland public procurement procedures hamper the selection of best bids and are not suitable for long-term contracts; Decision processes and financial procedures within public bodies are too complicated; Since ESCo schemes and contracts are rather complicated, laws regulating specifically contracting services would help to overcome basic insecurities. Furthermore, public procurement processes should be adapted in order to open this market to ESCo services.

In Croatian legislation, ESCo model is mentioned in Act on energy efficiency in direct consumption (OG 152/08). The act defines an ESCo and states that funds for energy services are ensured by contractor, i.e. ESCo, entirely or partially, from own sources or third parties, that contractor or a third party bears risks partially or entirely and that energy service is repaid through savings. Moreover, the Act formulates energy efficiency contract which has to include information on things such as the energy service client, third party financing, if there is any participating, primary energy consumption, guaranteed energy savings etc.

There is a procedure for insurance schemes to be incorporated in the ESCo project and also insurance of equipment is regulated by a contract with a producer/provider of equipment who guarantees for the equipment installed. As payment security instruments, HEP ESCo, currently the only ESCo in Croatia, uses different instruments depending on the type of the client. Type and number of instruments used depend on the evaluation of a client solvency.

4 Lessons Learned

A successful conclusion means a much more rapid uptake of renewables and sustainability packages more generally. At the moment, perceived risk and uncertainty is blighting the prospect for change to sustainable methods of both generating and using renewable energy. ESCos of the kind envisaged will make this jump in consciousness possible by managing those risks. The action should therefore draw in more organisations than would otherwise be the case and also speed up the rate at which organisations go forward with renewables.

The impact is likely to vary from one country to another. Those with most to gain are the countries with the least current activity as it is here that risks of change are proving to be most deleterious. The maximum benefit is likely to be with the public sector that is least able to cope with risks and change but where leadership must be given to encourage the private sector to engage and bring about mainstream renewable energy change.

Lessons learned:

- Energy agencies (and other organisations) providing expertise and assistance to e.g. municipalities in implementing contracting projects are crucial for increasing the uptake of contracting schemes;
- A well-organized contracting business sector is necessary to provide information on contracting scheme, to do lobbying in order to adapt laws, to standardize definitions and procedures, to provide advice and to provide tools to the sector;
- The establishment of a clear legislative framework capable to regulate all the contract related details is considered important since uncertainties resulting from unclear legal status are a main barrier to contracting uptake;
- Contractors offering the whole array of technologies and fuels can provide the most efficient concept depending on the project situation;
- Contracting is often not applicable in smaller projects with low investments. The pooling of buildings is an appropriate tool to increase project volumes;
- Standardized measurement and verification procedures are necessary;
- Project risk forecast and clear risk analysis are necessary;
- Need for increasing public awareness about ESCo projects and their economic and environmental benefits

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