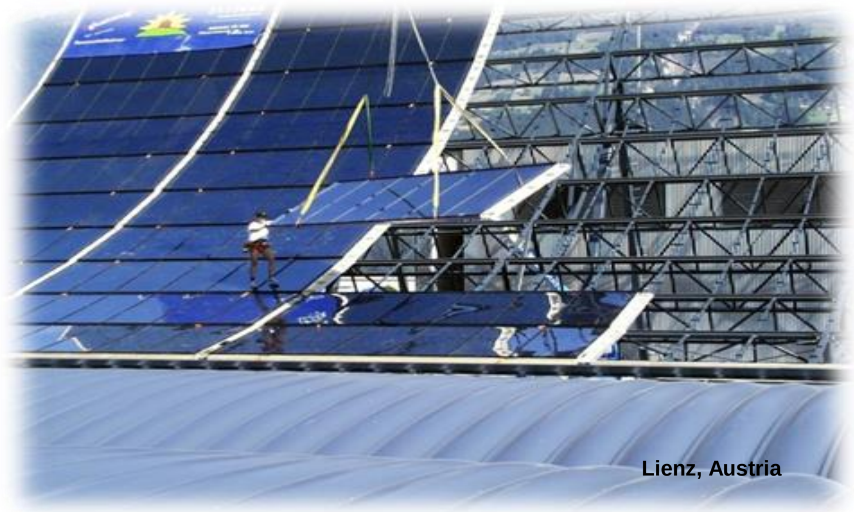
Task 45

Large Systems

Large solar heating/cooling systems,

seasonal storages, heat pumps



Subtask C, D 4 ESCo GUIDE

Models for ESCo Services, Revision 1

October, 2011

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1 Abstract

IEA Task 45, Subtask C, deliverable 4 focuses on a relatively new approach, energy service companies (ESCos) emerging as a way to increase the uptake rate of large scale solar heat projects in larger buildings in the public and private sector. 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.

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.

1.1 Rationale

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.

1.2 Report Objectives

This report will expand the use solar heat and cold in both the public and the private sector through:

Improved understanding of the approaches adopted by ESCos and promotion of this newly acquired knowledge among the EU solar thermal industries and potential users.

State-of-the-art exemplary energy services implementation in the use of solar heat.

2 Initial Situation

2.1 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.

2.2 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.

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

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									?			•					?	?						•				

•	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.

2.3 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.

3 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

3.1 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

4 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.

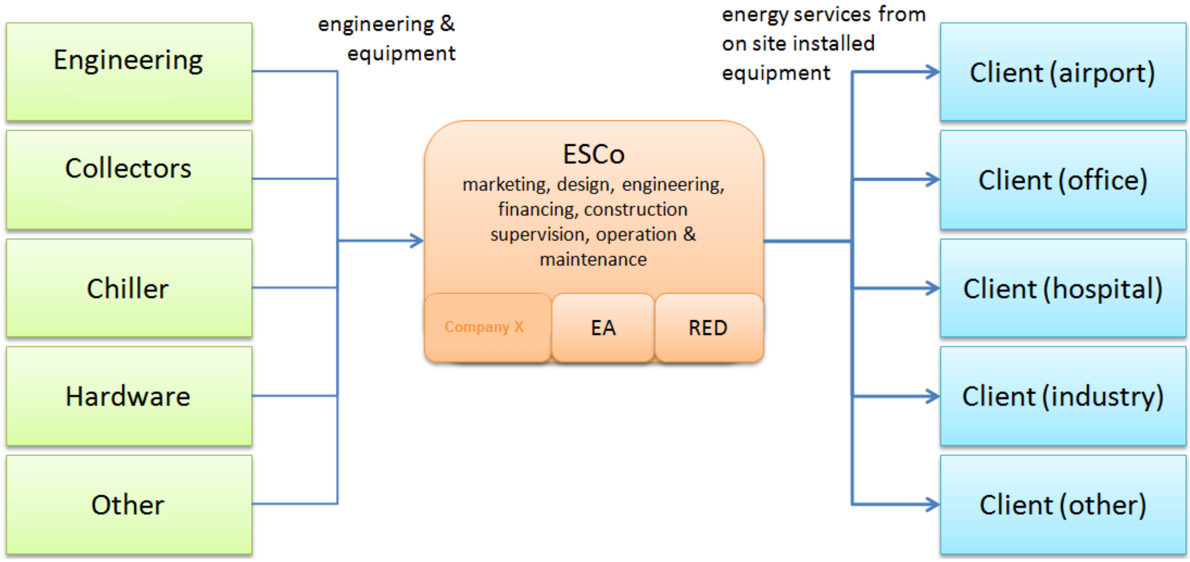
In many countries financial schemes and mechanisms to support projects in the fields of energy efficiency and renewable energy sources have been developed. These financial schemes are most of the times in the form of subsidies or low-interest loans. Many of the support mechanisms focus on energy efficiency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

4.1 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

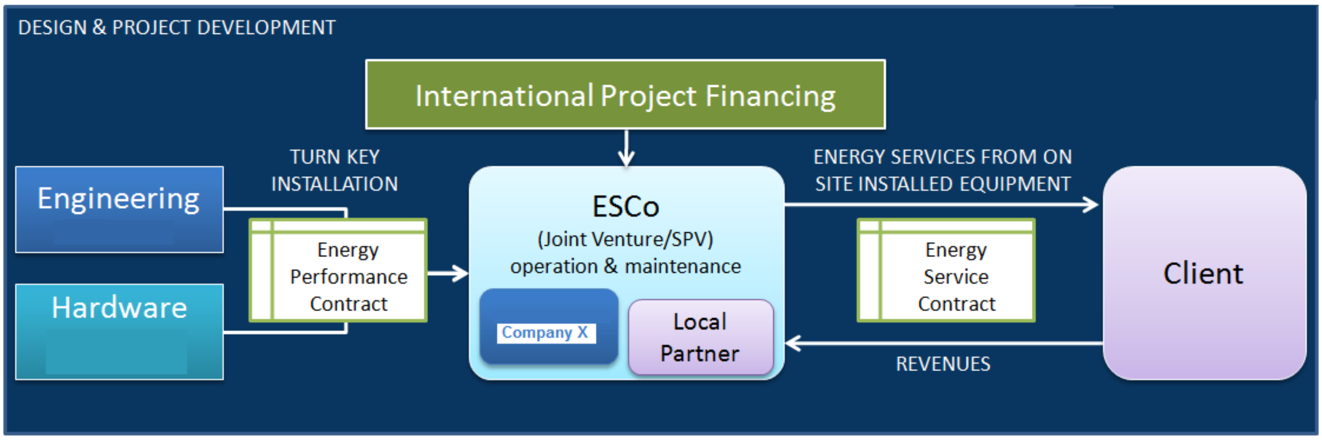
SEP = solar energy price per MWh solar energy (low)

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.



The principal Energy performance contracting (EPC) is shown on Figure 2

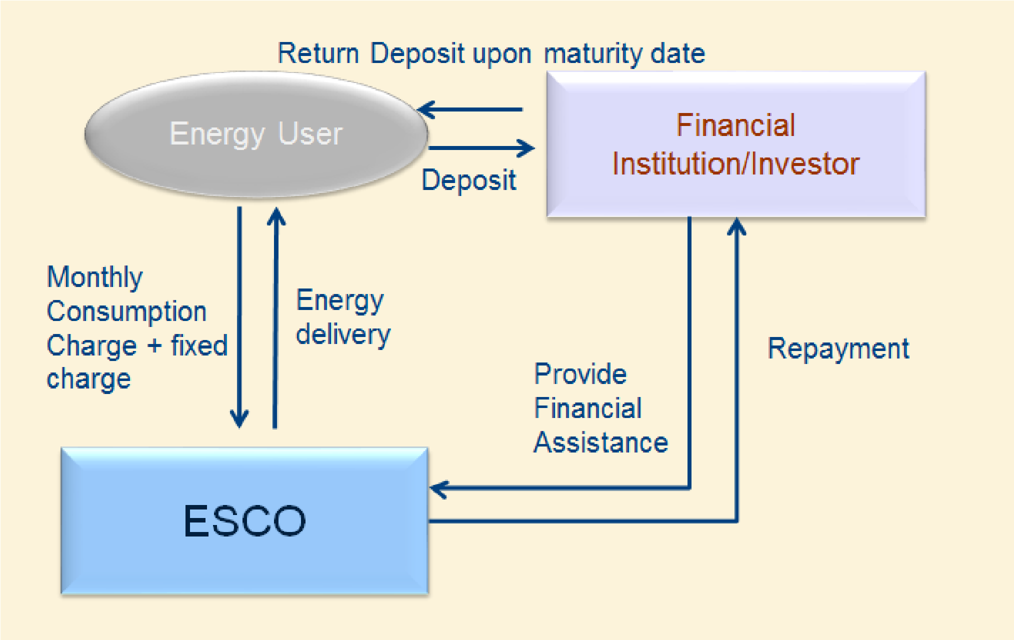
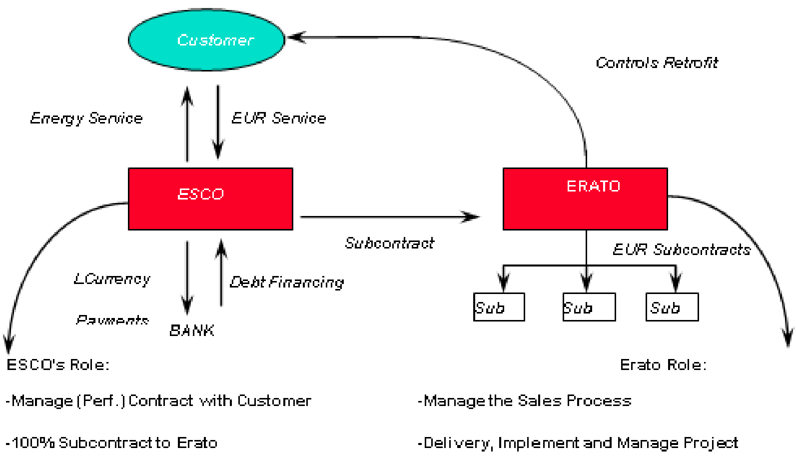


Figure 3 TPF Third party finance scheme

The principal heating delivery contracting (HDC) scheme is shown in Figure 4



4.2 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.

4.2.1 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

4.2.2 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.

4.2.3 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).

4.2.4 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.

4.2.5 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)

4.3 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

4.3.1 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.

4.3.2 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.

4.4 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

4.5 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.

5 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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7 Annex

ANNEXES

Annex I - TEMPLATE OF A SOLAR THERMAL EPC - ENERGY PERFORMANCE CONTRACT

Annex II - GENERAL CONSTRUCTION OBLIGATION OF [[ESCO]]

Annex III - HYDRAULIC SCHEME

Annex VI - GENERAL OBLIGATION OF [[CLIENT]]

Annex V - TIME TABLE

Annex VI - MASTER PLAN OF GENERAL CONTRACTOR

Annex VII - PERFORMANCE DATA

Annex VIII - VDI 2067

Annex IX - TARIFF

Annex X - DEED

Annex XI - FORMS OF CERTIFICATES, CHECKLISTS

Annex XII - BEST PRACTICE

Annex I
Template of a solar thermal EPC - Energy Performance Contract

SOLAR ENERGY PROVISION AGREEMENT

(NR: 00000)

BETWEEN

[[local ESCO, full name]],
[[Country]]

AND

[[CLIENT, FULL NAME]],
[Country]

FOR

[[CLIENT, FULL NAME]] Project XY,
[Country]

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PREAMBLE

THIS SOLAR THERMAL ENERGY PROVISION AGREEMENT ("*Agreement*") is entered into as of the DD. MMMM YYYY by and between

[[local ESCO, full name]], ([[ESCO]]), with its registered address at
Street, ZIP Code, Town, Country, Reg. Nr: xxxxxxxx

and

[[client, full name]], ([[CLIENT]]), located at Street, ZIP Code, Town, Country, with its registered address at Street, ZIP Code, Town, Country, Reg. Nr: xxxxxxxx

(together, the "*Parties*").

WHEREAS:

[[ESCO]] is engaged in the business of generating and selling heating and cooling energy through the installation of a Large Solar Thermal ("LST") system and related equipment;

[[CLIENT]] operates an {FACILITY} located in {Country}, which is planned to start its operation in MMMM YYYY ("[[CLIENT]]'s Facilities");

It has been agreed that a LST shall be constructed and owned by [[ESCO]], which in turn shall provide [[CLIENT]] with thermal energy for heating/cooling.

NOW, THEREFORE, in consideration of the premises and mutual covenants, conditions and agreements hereinabove and hereinafter set forth and such other good and valuable considerations, [[CLIENT]] and [[ESCO]], each intending to be legally bound DO HEREBY AGREE AS FOLLOWS:

DEFINITIONS

Except as otherwise expressly provided herein, all italic and capitalized terms used in this *Agreement* shall have the respective meanings as set forth below:

"*Acceptance Certificate*" shall mean the protocol to be signed by the *Parties* in accordance with clause 0 and Annex IV

"*Acceptance Date*" shall mean the day when acceptance has occurred in accordance with clause 0 and Annex IV.

"*Acceptance Test*" shall mean the test confirming the performance of the LST system as described in Annex IV

"*Commissioning Phase*" shall mean the period between MMMM YYYY and MMMM YYYY as per Annex III and Annex IV

"*Installer*" shall mean [[ESCO]] or its subcontractor carrying out the installation work for the *Solar Thermal Plant*

"*Deed*" shall mean the deed to be signed between [LAND OWNER] and [[ESCO]] as attached in Annex VII

"*Confidential Information*" shall mean information of commercial value which has been kept confidential by the Party from whom the information originates and which has not come into the public domain during the term of this *Agreement* in breach of any obligation of confidence

"*Documentation*" shall mean a detailed description of the LST and drawings of the entire *Solar Thermal Plant*

"VDI 2067" shall mean fundamentals and economic calculations of building installations in accordance to the instruction of VDE (Verein Deutscher Ingenieure) association of German engineers, as per Annex V

"*Effective Date*" shall mean the date when this *Agreement* is signed.

"*Fee*" shall mean the fees and charges for the provision of hot water as well as of cooling water as set out in clause 0 and Annex VI

"General Contractor" shall mean the company responsible for construction of the [[CLIENT]]'s facilities, hired by the [[CLIENT]].

"*Interfaces*" shall mean the interface between the *Solar Thermal Plant* and the hot water and cooling water distribution system to be installed by [[CLIENT]] as well as the interface between the *Solar Thermal Plant* and the roof of [[CLIENT]]'s Facilities. The I nnterfaces will be set out in the *Documentation*.

"*Installation Plan*" shall mean the time schedule set out in Time Table Annex III

"*Metering Equipment*" shall mean the meters measuring the quantities of solar energy consumed by [[CLIENT]], as per clause 0

"*Minimum Off-Take*" shall mean the minimum annual quantity of x,xxx,xxx.00 kWh of cooling water and of yyy,yyy kWh of hot water, to be consumed and paid for by [[CLIENT]].

"*Operations*" shall mean the activities as set out in clause 0

"*Project Manager*" shall mean a nominated representative of each Party who shall have the overall responsibility for the coordination from the installation phase up to *Acceptance Date*.

"*Solar Thermal Plant*" shall mean the large solar thermal system including all balance components such as cooling towers, storage tanks, control units [and energy efficiency componoents] to be installed by [[ESCO]] at [[CLIENT]]'s facilities.

"*Term*" shall mean the term of this *Agreement* as defined in clause 0.

SCOPE

[[ESCO]] shall install, maintain and operate the *Solar Thermal Plant* at [[CLIENT]]'s facilities for the *Term* and shall provide [[CLIENT]] with water heating and cooling energy in accordance with this *Agreement*.

[[CLIENT]] shall provide [[CLIENT]]'s Facilities fit for the installation of the *Solar Thermal Plant*, provide all *Interfaces* for such installation and shall procure and pay for its requirements of water heating and cooling energy in accordance with this *Agreement*.

CONSTRUCTION OF SOLAR THERMAL PLANT

[[ESCO]] shall install the Solar Thermal Plant at the premises of [[CLIENT]]'s facilities. Details of the Interfaces and timing are as agreed during tendering/engineering phase and detailed in Annex I and III. Any changes to the location or time shall be discussed and mutually agreed between the Parties. The Parties intend to fulfill their obligations in accordance with the master program as stipulated in the contract between [[CLIENT]] and the General Contractor so as to ensure that the project is not delayed or incurs additional costs.

The general obligations of [[ESCO]] during the construction, implementation phase and whilst the *General Contractor* has possession of site are detailed in Annex I. [[ESCO]] has employed *Installer* to perform its obligations.

The installation of the *Solar Thermal Plant* is planned to begin after this *Agreement* becomes effective and be finished in accordance with the *Installation Plan*. If the installation is delayed for any reasons whatsoever, the implementation plan shall be amended to take account of such delay. If [[ESCO]] can demonstrate that the delay has been caused by [[CLIENT]] and/or the *General Contractor* and has resulted in an increase in cost for the installation, [[ESCO]] may at its sole discretion invoice [[CLIENT]] for such cost. The *Parties* agree that such additional entitlement shall be the only consequence for any delay in installation.

If [[CLIENT]] requests any changes to the agreed upon design of the *Solar Thermal Plant*, the *Parties* shall meet and discuss the impact on time and cost. If such impact is agreed upon, [[ESCO]] shall ensure that the changes are implemented by the *Installer*.

Both *Parties* shall appoint a *Project Manager*, who shall have the responsibility and commensurate authority for the overall progress of the installation.

The general obligations of [[CLIENT]] during the *Term* are set out in Annex II. In order for [[ESCO]] to be able to have the *Solar Thermal Plant* installed, [[CLIENT]] shall prepare the *Interfaces* in accordance with [[ESCO]]'s directions.

[[CLIENT]] shall ensure that its hot and cold water distribution system is installed in accordance with all specifications and measurements and that it is functioning without defaults.

[[CLIENT]] undertakes to provide [[ESCO]] and the *Installer* during construction and operation of the *Solar Thermal Plant* free of charge with all required infrastructure and consumables such as electricity, water or internet access. Details are set out in Annex II.

[[CLIENT]] undertakes, within 14 days after the *Effective Date*, to transfer a cash deposit of EUR/USD XX,XXX,XXX ("*Deposit*") as an escrow into a bank account in the name of [[ESCO]] at Raiffeisen-Landesbank Steiermark AG Austria (RLB) as a security for payment of the *Minimum Off-ake*. [[ESCO]] undertakes, within two months after the *Effective Date*, to transfer an amount of EUR/USD xxx,xxx into the *Deposit*, so that the total amount of the *Deposit* shall be EUR/USD x,xxx,yyy. [[ESCO]] shall have the right to offset the *Deposit*, in whole or in part, in the event and to the extent that [[CLIENT]] at any time does not comply with its payment obligations under this *Agreement*. The *Deposit* shall be topped-up by

[[CLIENT]] in the amount of any such set-off within thirty days from the date of notice of such set-off by [[ESCO]].

Once the loans granted by RLB have been repaid by [[ESCO]], but latest on 1 January 20xx , the *Deposit* shall be paid back to [[CLIENT]] in equal annual tranches, such that the *Deposit* is refunded in full by the end of the initial term. [[ESCO]] shall be entitled to earlier repayments. Starting on the day of the first repayment by [[ESCO]] to [[CLIENT]], the *Deposit* shall become interest bearing at the [LIBOR/EURIBOR/..], calculated at the annual average rate.

ACCEPTANCE

Once the TOP has been issued, [[ESCO]] and the *Installer* shall begin with the commissioning/start up of the LST. [[ESCO]] shall give [[CLIENT]] at least 24 hours' notice of the start of the *Acceptance Test*s and permits [[CLIENT]] to observe the testing.

It is intended to have the *Acceptance Test* performed between April 20xx and June 20xx, so that rectification measures, if any, can be undertaken by [[ESCO]] until August 20xx. An *Acceptance Certificate* shall be issued by *Installer* and signed by [[ESCO]] when the *Acceptance Test* has been performed successfully. The energy produced by the LST from the date of issuance of the *Acceptance Certificate* shall be consumed and paid by [[CLIENT]].

Details of the commissioning period and the *Acceptance Test* as well as rectification measures (Certificates, Checklists), if any requested by [[CLIENT]], are set out in Annex IV.

OWNERSHIP OF THE SOLAR THERMAL PLANT

Title to the *Solar Thermal Plant* shall remain at all times with [[ESCO]].

[[CLIENT]] shall either obtain or support [[ESCO]] in obtaining all necessary approvals from relevant authorities for the installation, operation and maintenance of the *Solar Thermal Plant*.

[[CLIENT]] shall not remove, alter (except as otherwise required or permitted under this *Agreement*) or assign, pledge, mortgage, permit any lien to exist on the *Solar Thermal Plant*. For the avoidance of doubt, [[CLIENT]] unreservedly acknowledges that the *Solar Thermal Plant* shall not constitute part of the actual building and throughout the *Term* shall not cause damage to or permit anything which may damage the *Solar Thermal Plant*.

EASEMENT

[[CLIENT]] shall grant, or cause to be granted, to [[ESCO]], its representatives and/or agents all rights-of-way, access rights, easements, licenses and other rights with respect to [[CLIENT]]'s facilities as are necessary for [[ESCO]] to perform its obligations and exercise under this *Agreement*. [[CLIENT]] shall obtain, or cause to be obtained (in form and substance satisfactory to [[ESCO]]) non-disturbance agreements or, if applicable, waivers and/or consents from each of its mortgagees or landlords with respect to all rights of way, access rights, easements, licenses and other property rights which [[ESCO]] requires to perform its rights and obligations under this *Agreement*.

Any access shall be in compliance with safety, security and operational requirements of [[CLIENT]].

The *Parties* shall, upon [[ESCO]]'s request, execute a separate agreement, based on the acceptance of the building owner, for the grant of such rights-of-way, access rights, easements, licenses and other rights in relation to the obligations contained in this *Agreement*, especially unobstructed access to the *Solar Thermal Plant.*

OPERATIONS

Within 10 days of commencement of commissioning and start up of the *Solar Thermal Plant*, [[ESCO]] shall operate the *Solar Thermal Plant* for the *Term*. [[CLIENT]] shall ensure that it can consume all energy generated by the *Solar Thermal Plant* during the commissioning phase (start up – *Acceptance Date*).

The full operation and generation of energy is estimated to start DD MMMM YYYY. At this date the *Solar Thermal Plant* shall be handed over from the *Installer* to [[ESCO]]. The generated energy will be charged according to the Tariff as set out in Annex VI from the date of the *Acceptance Certificate*.

The *Operations* shall consist of the following activities of [[ESCO]]:

Annual servicing of the *Solar Thermal Plant* in accordance with the respective specifications of the manufacturer; and

Maintenance and repair in case of defects of the *Solar Thermal Plant*; and

Constant supervision and optimizing of the operation of the *Solar Thermal Plant* via telemonitoring facilities; and

Modifications as well as replacement of non-economical parts of the *Solar Thermal Plant* as deemed necessary by [[ESCO]]; and Provision of online data and the input information of the *Solar Thermal Plant* for the educational system of [[CLIENT]]. The monitoring hardware and graphical displays will be provided by [[CLIENT]].

In case of any works at the *Solar Thermal Plant*, [[ESCO]] shall be entitled to suspend the provision of water heating and water cooling for the period required to conduct such works. If possible, [[ESCO]] shall notify [[CLIENT]] sufficiently in advance of such works.

The cost of *Operations* shall be borne by [[ESCO]] and are included in the *Fee*. However, the cost for any defect which has not been caused by the willful misconduct or gross negligence of [[ESCO]] shall be paid for by [[CLIENT]].

[[CLIENT]] shall ensure that [[CLIENT]]'s facilities, its hot and cold water distribution system as well as all *Interfaces* are at all times properly maintained and fully functioning to supply hot and cold water, in order to ensure the performance of the *Solar Thermal Plant*. [[ESCO]] shall ensure that the LST is at all times properly maintained and fully functioning.

[[CLIENT]] shall provide the following, free of charge, during the *Term* a connection (*Interfaces*) and in house distribution system for hot and cold water of sufficient size and quality, properly maintained at all times, for the supply of hot and cold water; and electrical connectivity which ensures a secure and undisturbed operation of the *Solar Thermal Plant*; and sufficient electric energy/power supply to ensure a proper function of all equipment of the *Solar Thermal Plant*; and a water supply and discharge system of sufficient size and quality; and sufficient water for re-cooling the cooling towers of the *Solar Thermal Plant*. The demand will be between 8 – 10 liters per kWh cooling production *Solar Thermal Plant*. water for the filling of the *Solar Thermal Plant*; and all necessary permissions and approvals in the country for the operation of the *Solar Thermal Plant* as a user a data link with continuous internet access for the supervision of the *Solar Thermal Plant*.

Details are set out in Annex I and II and VI (consumption figures).

SUPPLY AND CONSUMPTION OF SOLAR ENERGY

[[ESCO]] undertakes to provide an annual minimum amount of solar energy equal to the *Minimum Off-Take*. If in any year [[ESCO]] should not be able to provide the *Minimum Off-Take* for reasons [[ESCO]] is responsible for, [[ESCO]] shall be obliged to optimize the *Solar Thermal Plant* over a period of three (3) years.

[[CLIENT]] undertakes to consume all energy generated by the *Solar Thermal Plant* and provided at the agreed *Interfaces*.

If [[CLIENT]] is not able, for operational reasons, to take all the energy provided by the *Solar Thermal Plant*, [[CLIENT]] shall be obliged to pay for the *Minimum Off-Take* at the then relevant *Fee*.

[[CLIENT]] shall, as a back-up, operate its own energy system for cooling and hot water which shall provide energy if and to the extent the energy provided by the *Solar Thermal Plant* is not sufficient to cater for [[CLIENT]]'s needs.

The *Metering Equipment* as per [country/institution] standard shall be installed and maintained by [[ESCO]] and remain, during the *Term*, the property of [[ESCO]]. All quantities of energy measured at the meter are considered consumed by [[CLIENT]].

All *Metering Equipment* calibrated to kWh (heat meter) will be tested and calibrated by [[ESCO]] periodically in accordance with the manufacturer's instructions and good industry practice and standards. Test and calibration records will be issued to [[CLIENT]] upon request. Further, [[CLIENT]] may request additional meter tests at any time; provided, however, if a meter is subsequently found to have a variance for accuracy in accordance with EN 1434 (European Standard for heat meters) or adequate country's regulation, [[CLIENT]] will bear the cost of such testing. The country's standards if available shall prevail.

FEES

The fee for the provision of hot water shall consist of a monthly base price and an operating price and shall be calculated in accordance with Annex VI.

The fee for the provision of cooling water shall consist of a monthly base price and an operating price and shall be calculated in accordance with Annex VI.

The *Fee* shall be adapted on a semi-annual basis in accordance with the formula set out in Annex VI.

PAYMENT

The *Fee* is net of any taxes, duties or other disbursements, which shall be borne by [[CLIENT]]. However the invoice, stipulating the fee, will include GST, which is payable by [[CLIENT]].

[[ESCO]] shall issue invoices on a monthly basis. The invoices shall be based on the projected annual off-take of hot and cooling water and the prevailing energy prices. Details are set out in more detail in Annex VI.

Payments shall be due and payable within 14 days from the date of invoice. In case of delayed payments, interest of 10% above [LIBOR/EURIBOR] shall accrue on a daily basis.

Within 28 days after the end of each calendar year [[ESCO]] shall provide [[CLIENT]] with an overview of the quantities consumed during the previous year and the respective fee ("Annual Account"). The difference between the payments invoiced during the previous year and the payments calculated based on actual consumption shall be accounted for in the invoice of the month following the provision of the Annual Account.

Objections against the Annual Account may be raised by [[CLIENT]] within a period of thirty days of receipt of the Annual Account. Thereafter the Annual Account is considered approved.

[[ESCO]] shall be entitled to demand a pre-payment of the *Fee* up to an amount of two monthly payment rates if payments have been overdue for more than twenty days.

In case of any damage of the metering equipment [[ESCO]] is entitled to bill on the basis of the *Minimum Off-Take* in respect of the time quantities have not been measured correctly.

TERM AND TERMINATION

This *Agreement* shall be in full force and effect and be legally binding upon the *Parties* and their permitted successors and assigns as of the date hereof and shall remain in effect for a term of twenty (20) years as of the *Acceptance Date* ("*Initial Term*"). After this time this *Agreement* can be extended by mutual agreement at terms to agreed at that time.

This *Agreement* may be terminated in writing by registered letter with immediate effect by [[ESCO]]:

if [[ESCO]] is prevented, by [[CLIENT]] or any party claiming rights to [[CLIENT]]'s facilities or the land to which such facilities are attached, from accessing [[CLIENT]]'s facilities and the *Solar Thermal Plant* and conducting the *Operations* for a period of no less than two (2) weeks, and [[CLIENT]] has, after being officially informed about such restrictions, not removed such restrictions within a period of two (2) months; or

if payments are overdue for more than three (3) months; or

if [[CLIENT]] does not sign the *Deed* on or before DD.MMM YYYY.

This *Agreement* may be terminated in writing by registered letter with immediate effect by either Party, if the other Party commits a material or persistent breach of any of its obligations under this *Agreement* and (in the case of a breach capable of being remedied) does not remedy such breach within 30 days of receiving from the other Party written notice of the breach and a request to remedy the breach.

distress or execution is levied on the other Party's property or if the other Party has a receiver, administrator, administrative receiver or manager appointed over the whole or any part of its assets, becomes insolvent, compounds or makes any arrangement with its creditors, commits any act of bankruptcy, is wound up or goes into liquidation, or if the other Party suffers any analogous proceedings under foreign law

RIGHTS AND OBLIGATIONS AFTER TERMINATION

In case of termination by [[CLIENT]], [[CLIENT]] shall be entitled to (1) either purchase the *Solar Thermal Plant* at its book value, including cost of financing and further investments as determined in accordance with VDI 2067, if [[ESCO]] could not nominate a successor in title, who undertakes to take over the full obligation (professional operation and maintenance of the LST) of this *Agreement*, or (2) have the *Solar Thermal Plant* removed at no cost to [[CLIENT]].

In case of termination by [[ESCO]], [[ESCO]] shall have the option to (1) sell and [[CLIENT]] shall be obliged to purchase the *Solar Thermal Plant* at its book value, including cost of financing and further investments as determined in accordance with VDI 2067 plus the *Fee* for the *Minimum Off-Take* calculated until the end of the Initial *Term* ; or (2) to remove the *Solar Thermal Plant* from [[CLIENT]]'s facilities with all costs of removal to be borne by [[CLIENT]]. In case of termination by [[ESCO]] under clause 0, [[CLIENT]] shall be obliged to reimburse all cost incurred by [[ESCO]] in relation to the engineering, installation and equipment up to the date of termination.

At the end of the Initial *Term* or any extension thereof, [[ESCO]] shall have the choice to either sell the *Solar Thermal Plant* to [[CLIENT]] at its book value, including cost of financing and further investments as determined in accordance with VDI 2067or to remove it from [[CLIENT]]'s Facilities.

Termination shall not affect or prejudice any right to damages or other remedy which the terminating party may have in respect of the event giving rise to the termination or any other right to damages or other remedy which any party may have in respect of any breach of this *Agreement* which existed at or before the date of termination.

[[ESCO]]'S WARRANTIES

[[ESCO]] warrants that the *Solar Thermal Plant* will be new, of good quality and of latest state of art of LST systems.

During installation and building the *Solar Thermal Plant* [[ESCO]] shall ensure that *Installer* shall follow strictly the local laws and regulations.

[[ESCO]] warrants that the *Solar Thermal Plant* during the *Term*, will provide the annual *Minimum Off-Take* quantities, if [[CLIENT]] fulfils its obligations under clause 3 and the *Operations* were not hindered for reasons of Force Majeure or third party's actions or inactions. The sole remedy for breach of the warranty under this clause 0 shall be correction of defects by [[ESCO]] within a reasonable time from notification by [[CLIENT]] of the defect.

The above warranties are in lieu of all other express or implied warranties or conditions including, but not limited to, implied warranties or conditions of merchantability and fitness for a particular purpose.

[[ESCO]] specifically denies any implied or express representation that the *Solar Thermal Plant* will be fit to operate in conjunction with any other *Interfaces* than those identified in the *Documentation* or to operate uninterrupted or error-free.

Any unauthorised modifications, use or improper installation of the *Solar Thermal Plant* by [[CLIENT]] shall render all the [[ESCO]]'s warranties and support obligations null and void.

Subject to clause 0, [[ESCO]] shall defend, hold harmless and indemnify [[CLIENT]] against all loss, damage, claims, liabilities, fees, costs and expenses arising out of any action brought against [[CLIENT]] based on a claim that the *Solar Thermal Plant* infringes any intellectual property right of any third party, provided that:

[[ESCO]] is notified promptly in writing of any such claim;

[[CLIENT]] makes no admission or settlement of such claim without [[ESCO]]'s prior written consent;

[[ESCO]] has sole control of the defence and any negotiations for compromise; and

[[CLIENT]] provides, at [[ESCO]]'s expense, such assistance as [[ESCO]] reasonably requires.

If the *Solar Thermal Plant* becomes or, in the opinion of qualified legal counsel, is likely to become, the subject of any such claim, [[CLIENT]] will permit [[ESCO]] to replace all or part of the *Solar Thermal Plant* without any charge to [[CLIENT]]; and/or to modify the *Solar Thermal Plant* as necessary to avoid such claim; and/or to procure for [[CLIENT]] a licence from the relevant complainant to continue using the *Solar Thermal Plant*.

[[ESCO]] shall have no liability for any claim of intellectual property infringement resulting from any unauthorised modification of the *Solar Thermal Plant*.

[[CLIENT]]'S WARRANTIES

[[CLIENT]] warrants to provide [[CLIENT]]'s facilities fit for the installation of the *Solar Thermal Plant*, provide all *Interfaces* for such installation and to procure and pay for its requirements of water heating and cooling energy in accordance with this *Agreement*.

[[CLIENT]] warrants not to remove, alter (except as otherwise required or permitted under this *Agreement*) or assign, pledge, mortgage, permit any lien to exist on the *Solar Thermal Plant*.

LIABILITY

To the extent not covered by the insurances described under clause 0, [[ESCO]]'s entire liability under this *Agreement* or for any cause of action related to the *Solar Thermal Plant* shall be limited to EUR X,000,000. [[ESCO]] shall not be liable for any incidental, special, direct or consequential damages of any nature, including lost profits and opportunity costs in connection with or resulting from performance or non-performance of their respective obligations under or in connection with this *Agreement*.

The exclusions in this clause 15 shall apply to the fullest extent permissible at law, but [[ESCO]] does not exclude liability for death or personal injury caused by the negligence of [[ESCO]], its officers, employees, [[ESCO]]s or agents for fraud or any other liability which may not be excluded by law.

INSURANCE

During construction and until *Acceptance Date* [[ESCO]] shall maintain or have maintained such insurances as are required by [the national authorities] to cover the liability of [[ESCO]] in respect of personal injuries or death or damage to property and caused by any negligence, omission, breach of *Agreement* or default of the [[ESCO]], his servants or agents or any person employed or engaged upon or in connection with the installation of the *Solar Thermal Plant*. Furthermore [[ESCO]] shall maintain an insurance to cover the liability of [[ESCO]] in respect of personal injuries or death or damage to property and caused by the operation of the *Solar Thermal Plant*.

Upon *Acceptance Date*, [[CLIENT]] shall insure and keep insured during the *Term* the *Solar Thermal Plant* in the joint names of [[CLIENT]] and [[ESCO]] against all damage, loss or injury from whatever cause arising up to the value determined by [[ESCO]]. Such insurance shall be effected with an insurer in terms approved by [[ESCO]]. In the event that [[CLIENT]] defaults in taking out or maintaining such insurance policies as aforesaid, [[ESCO]] (without prejudice to any other rights or remedies available) may itself insure against any risk in respect of which the default has occurred and any amount paid by it in respect of premiums shall be recoverable from [[CLIENT]].

FORCE MAJEURE

Neither [[CLIENT]] nor [[ESCO]] shall be in default in respect of any obligation under this *Agreement* if the Party is unable to perform its obligation by reason of an event of Force Majeure, provided that the suspension of performance shall be commensurate with the nature and duration of the event of Force Majeure and the non-performing party is using its best efforts to restore its ability to perform.

Force Majeure shall mean any event that prevents or delays a Party from performing in whole or in part any obligation arising under this *Agreement* and neither was within the reasonable control of the non-performing Party nor could have been prevented by reasonable actions taken by the non-performing Party, including, without limitation, an act of God, explosion, fire, lightening, earthquake, storm, civil disturbance, strike, lock-out, changes in law, orders of governmental authorities, and equipment failures that are not due to the negligence of the non-performing party.

ASSIGNMENT

Neither Party shall assign this *Agreement* without first having obtained the written consent of the other Party, provided, however, that either Party may assign its rights and delegate its duties hereunder without first obtaining the other Party's consent to any subsidiary or affiliated entity controlled by the assigning party, on the condition that the assignee agrees in writing to assume all of the obligations of the assigning party hereunder.

NOTICES

Any notice required to be given under this *Agreement* shall be sufficiently served if sent by facsimile (subject to confirmation of receipt by the receiving Party), telegram, registered post, courier or hand and addressed to the principal or registered office of the Party to be served. Any such notice shall be deemed to have been received and given at the time when in the ordinary course of transmission it should have been delivered at the address to which it was sent. However, all official court related process shall be served according to the Rules of Court.
The initial point of contact shall be as stated in clause 0.

CONFIDENTIALITY

Each of the *Parties* shall treat as confidential all *Confidential Information* of the other Party supplied under or in relation to this *Agreement*. No Party shall divulge any such *Confidential Information* to any person except to its own employees and then only to those employees who need to know the same. Each Party shall ensure that its employees are aware of, and comply with, the provisions of this clause. The foregoing obligations shall remain in full force and effect notwithstanding any termination of this *Agreement*.

PROMOTION

The *Solar Thermal Plant* and its utilization by [[CLIENT]] may be used by both *Parties* as a reference project towards third parties. The *Parties* therefore shall undertake all reasonable endeavors to support each other's requests for the presentation of the *Solar Thermal Plant*.
Both *Parties* agree that each can make use of the LST at [[CLIENT]] facilities for advertising and public relations purposes like: pictures, videos, internet links, visitors of potential clients, etc. However [[CLIENT]] retains the control of visitors, but the permission to visit the LST together with prospective [[ESCO]] clients should not be unreasonably withheld.

WAIVER

No right under this *Agreement* shall be deemed to be waived except by notice in writing signed by the waiving Party. The failure of either Party to enforce, at any time or for any period of time, the provisions hereof or the failure of any Party to exercise any option herein shall not be construed as a waiver of such provision or option and shall in no way affect that Party's right to enforce such provisions or exercise such option. No waiver of any provision hereof shall be deemed a waiver of any succeeding breach of the same or any other provision of this *Agreement*.

ENTIRE AGREEMENT, ORDER OF DOCUMENTS

The *Agreement* constitutes the entire agreement between the *Parties* with respect to the matters contained herein and replaces any previous document, agreements and commitment whether oral or written. No amendment or modification hereof shall be binding unless duly executed by both *Parties*. In case of any discrepancies between this *Agreement*, its Annexes and the *Documentation*, the *Agreement* shall have priority over the Annexes and the Annexes shall have priority over the *Documentation*.

SEVERABILITY

Any provision hereof that is prohibited or unenforceable in any jurisdiction shall, as to such jurisdiction and to the fullest extent permitted by applicable law, be ineffective to the extent of such prohibition or unenforceability without invalidating the remaining provisions hereof and without affecting the validity or enforceability of any provision in any other jurisdiction.

COUNTERPARTS

This *Agreement* may be executed in separate and several counterparts, each of which shall be deemed an original and all of which shall constitute one and the same instrument.

THIRD PARTY RIGHTS

This *Agreement* and the documents referred to in it, are made for the benefit of the *Parties* to them and their successors and permitted assigns and are not intended to benefit, or be enforceable by, anyone else.

AUTHORITY

Each party warrants that it has full capacity and authority, and all necessary licenses, permits and consents to enter into and perform this *Agreement* and that those signing this *Agreement* are duly authorized to bind the Party for whom they sign.

APPLICABLE LAW

This *Agreement* shall be construed in accordance with and shall be enforceable under the laws of [COUNTRY].

DISPUTE RESOLUTION

Any dispute arising out of or in relation to this *Agreement* shall be referred to and finally resolved by arbitration in [COUNTRY] in accordance with the Arbitration Rules of the [Arbitration Authority] for the time being in force which rules are deemed incorporated by reference to this Clause. The Tribunal shall consist of three arbitrators. The decision of such Tribunal shall be final and binding upon the *Parties*. The language of the arbitration shall be [LANGUAGE].

CORRESPONDENCE & REGISTERED ADDRESS

All the correspondence, invoices, credit or debit notes, etc., must be issued in the name of [[CLIENT]] must be addressed to:

[[CLIENT, FULL NAME]]
Address
Address
ZIP Code, Town
Email: name@domain.suffix
Tel: +xx yyy zzzzzzzz Mobile: +xx yyy zzzzzzzz
Fax: +xx yyy zzzzzzzz

All the correspondence with [[ESCO]] must be duly identified with either of the ESCo *Agreement* or related references and addressed to:

[[local SOLID ESCO subsidiary, full name]]
Address
Address
ZIP Code, Town
Email: name@domain.suffix
Tel: +xx yyy zzzzzzzz Mobile: +xx yyy zzzzzzzz
Fax: +xx yyy zzzzzzzz

IN WITNESS WHEREOF the *Parties* have caused this *Agreement* to be duly executed and delivered as of the date and day first above written

……………………………………………. ……………………………………………….
Date, Place Date, Place

…………………………………………… ………………………………………………..
[[local ESCO, full name]] [[CLIENT, FULL NAME]]

Annex II

GENERAL CONSTRUCTION OBLIGATION OF [[ESCO]]

General CONSTRUCTion Obligation of [[ESCO]]

[[ESCO]] shall, with due care and diligence, design, execute and complete the *Solar Thermal Plant* fit for Acceptance as detailed in Annex IV. [[ESCO]] shall provide all superintendence, labour, Plant, Construction Equipment, materials, goods and all other things, whether of a temporary or permanent nature required in and for such design, execution and completion of the *Solar Thermal Plant* as per Clause 3 of this *Agreement* and shall remedy any defects.

Without prejudice to the generality of paragraph (1) of this sub-clause, and to [[ESCO]]'s obligations under the *Agreement*,

a. [[ESCO]] shall be fully responsible for the design of the *Solar Thermal Plant*, and shall complete the design in accordance with [[CLIENT]]'s plans

b. [[ESCO]] shall be fully responsible for the choice of materials, goods, plants, workmanship to enable the *Solar Thermal Plant* to be constructed and completed and/or be fully operational in accordance with [[CLIENT]]'s plans;

c. [[ESCO]] shall be fully responsible for the preparation, development and coordinating of all design *Solar Thermal Plant* and construction at all stages of the *Solar Thermal Plant* from design stage to completion and use of the *Solar Thermal Plant*, including the obtaining of all necessary licenses and approvals as may be required by the authorities or under any enactment, order, ruling or regulation; except Clause 6 of this *Agreement*;

d. [[ESCO]] shall be fully responsible for the adequacy, stability and safety of the installation of the LST ;

EMPLOYMENT OF QUALIFIED PERSONNEL

The [[ESCO]] shall engage suitably qualified installer/personnel as required by relevant applicable laws to install the Solar Thermal Plant. All fees, costs and expenses so incurred by [[ESCO]] shall be deemed to be included in the Agreement Sum.

Where an Accredited Checker or Registered Inspector is required for the Solar Thermal Plant, they shall be engaged by [[CLIENT]].

No person shall be engaged by [[ESCO]] if [[CLIENT]] on reasonable grounds objects to the engagement of such qualified personnel, in which event [[ESCO]] shall promptly nominate and engage other suitably qualified personnel.

SUFFICIENCY OF *SOLAR THERMAL PLANT*

The [[ESCO]] shall be deemed to have satisfied himself before submitting the documentation as to the correctness and sufficiency of the *Solar Thermal Plant*, which shall be deemed to cover all his obligations under the *Agreement* and all matters and things necessary for the proper design, execution, completion and operation of the *Solar Thermal Plant*.

The [[ESCO]] shall be deemed to have reviewed all of the *Agreement* and have satisfied himself that the drawn and written information provided in the *Agreement* are sufficient and adequate to enable him to prepare, complete and bring the [[ESCO]]'s *Solar Thermal Plant* to full completion in accordance with the *Agreement*..

DESIGN, SPECIFICATIONS AND OTHER INFORMATION

[[ESCO]] shall design and provide all necessary specification for the *Solar Thermal Plant* in accordance with the site plans and requirements of [[CLIENT]]. Any design detail, plan, drawing, specification, note, annotation and information required shall be provided by [[ESCO]] in such sufficient format, detail, extent size and scale and within such time as may reasonably be required to ensure effective execution of the *Solar Thermal Plant* and/or as otherwise required by [[CLIENT]]. An overall view of [[ESCO]] concept/design is shown in the enclosed Hydraulic scheme.

PRIOR WRITTEN ACCEPTANCE

[[ESCO]] shall make any material deviation, alteration, addition and/or omission from the accepted design without the prior acceptance in writing by the [[CLIENT]], if it turns out that such alteration is more economical or technically feasible and to the benefit for the parties. Any acceptance or approval by [[CLIENT]] of such submission shall not relieve or in any way limit the responsibility of the [[ESCO]] under the *Agreement*.

ANNEX III

HYDRAULIC SCHEME

Annex IV

GENERAL OBLIGATION OF [[CLIENT]]

[[CLIENT]] GENERAL RESPONSIBILITIES

In addition to the obligations and responsibilities of [[CLIENT]] as stipulated in this *Agreement* the following precautions, preparations, coordination, supplies, etc., shall be provided in time by [[CLIENT]]:

1) The in-house ACMV installation must be designed, installed (of state of the art) and in accordance with international standards (Comparable to DIN, ISO, EU standards).

2) Adequate space for the technical rooms (for the solar components, equipment and control units) must be given and allocated for the solar system, provided that these required spaces are requested from the [[CLIENT]] at the earliest possible time.

3) Statics Requirements

    a. Design, supply and mounting of the supporting structures for the installation of the collectors, cooling machine and the cooling tower.

    b. The statics requirements are to be checked by the [[CLIENT]].

    c. The exact weight and size of the above mentioned components will be submitted during detailed engineering phase.

    d. Foundation must be adequate for storage tanks, cooling machine, cooling tower and other heavy equipment.

4) The dimensioning of individual foundations must be in accordance with local building laws and regulations, which shall be carried out by a qualified engineer provided by the [[CLIENT]]. The location of the foundation blocks will be nominated by [[ESCO]].

5) The cranes and operators shall be allocated by [[CLIENT]] to [[ESCO]] for the installation of the collectors (lifting devices, tools and tackles to position chiller and other heavy equipment), in accordance to the time schedule as specified in Annex III.

6) Delivery and mounting of substructure and elevation for collector field.

7) All material for back-filling of pipe trenches

8) Gas connection for preparing domestic hot water backup system.

a. A gas connection system and an adequate chimney has to be provided by [[CLIENT]]

b. [[ESCO]] shall be informed in written form by [[CLIENT]] about the type of gas (i.e. liquid gas: propane, butane, or natural gas etc).

9) Allocation of shafts/ducts/trenches for the risers from the roofs to the technical rooms.

10) Distribution system of chilled water:

a. Provision of the whole pipe work after the chilled water pump unit (Pump unit 3).

11) Distribution system of domestic hot water.

a. Provision of the inflow of the cold water pipe into the hot water tank and the outflow of the hot water pipe to the distribution system.

12) Continuous internet connection near the control unit shall be made available.

13) The [[CLIENT]] has to provide the followings for remote monitoring:

a. Network access for internet
b. Broadband access, minimum 56k/bps
c. Dynamic IP address
d. Electricity supply

14) Installation of the power connection for the cooling machine and the pumping groups (wattages will be submitted after detailed engineering and procurement phase).

15) Water supply

a. To supply all utilities, water, personnel (maintenance group) for filling the entire solar system (tanks, pipes, collectors, etc) with water for testing and commissioning of the LST under the supervision of the [[ESCO]].

16) Water treatment

a. The supply of fresh water has to be treated chemically by [[CLIENT]] before it flows into the re-cooling system.

b. [[ESCO]] will take care of the biological treatment after the re-cooling system. (According to EU standards, a biological water treatment is needed after the cooling tower due of the settlement of bacteria in the re-cooling system.) All costs of such treatment shall be borne by [[CLIENT]]

17) Allocation of potential equalizing bar, according to the [COUNTRY] law and regulations.

18) Lightning protection system (if needed according to [COUNTRY] law).

19) Fire preventions as required by [COUNTRY] law.

20) Precautions, proper design of drainage systems in the technical rooms. Special requirements and data will be submitted by the [[ESCO]] during detailed engineering phase.

Annex V

TIME TABLE

The below timetable only indicates the projected milestones according to the current progress of the project.

Table 1. Synopsis of Milestones and Responsibilities

Milestone	Start Date	End Date	Prerequisite Conditions	Responsible Company
Approval of ESCO Agreement			[[CLIENT]]	[[CLIENT]]
Coming into force ESCo Agreement			Deposit transfer [[CLIENT]]	[[CLIENT]]
Start of installation (Piping)			Coming into force of ESCo *Agreement*, Receipt of Deposit	
Start Procurement of Equipment			Coming into force ESCo *Agreement*	
Delivery of Equipment			Coming into force LoI/ESCo A	
Readiness of Technical Room, Roof Steel Structure & Grand Stand			Acceptance of	[[CLIENT]]
Installation of Equipment & Collectors			Acceptance of	
Function-Test, Start up LST			Testing Filling LST	
Adjusting Optimizing LST (Energy generating)			TOP	
Start up & Performance Tests LST			Functioning & Performance Test LST	
Readiness to Supply Heat & Cold			Readiness of Heat & Cold Distribution System	
Continuous Energy Generating & Delivery			[[CLIENT]]	

Annex VI

MASTER PLAN OF GENERAL CONTRACTOR

Herewith also is enclosed in this Annex as reference the entire installation plan (Master Plan Rev. XXXX) provided by the *General Contractor*, for the [[CLIENT]]'s project.

Annex VII

PERFORMANCE DATA

The enclosed monthly yield data stipulates the performance of the *Solar Thermal Plant*. During commissioning period the calibrated heat meters (metering equipment) will be jointly inspected and the below list of monthly yield now in MBTU shall be converted according to the units displayed at the heat meters as well as recorded in the control system.

Table 1 Monthly Yield of LST

SOLID Energy Services

Monthly YIELD

Customer:
Project:
Prize Basis:
Installed Capacity:

MONTH	MINIMUM [MBTU]		MAXIMUM [MBTU]	
	Cooling	Hot water	Cooling	Hot water
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				
TOTAL				

	MINIMUM [kWh]		MAXIMUM [kWh]	
	Cooling	Hot water	Cooling	Hot water
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				
TOTAL				

Test Procedure, Start-up, Consumption of produced Energy, Optimizing

a) Commissioning

Immediately after completion of the installation (also partly) of LST, the *Installer* will carry out the cleaning and testing. [[CLIENT]] representatives will have the right to participate during Commissioning of the LST at [[CLIENT]] Campus. During the filling, the *Installer* will carry out mechanical functional test of each individual equipment (pump, control valve, motor, control system, etc.) installed and also perform the leakage and tightness tests of the hydraulic system. The Commissioning Period shall be approximately 3-4 months.
After the Commissioning, the LST will be started up and put into operation and all necessary parameters and data for the normal operation to generate Energy shall be met according to estimated average yield as set out in Table 1 under this Annex.

b) *Acceptance Test*s

The *Acceptance Test*s shall be conducted by *Installer* under the supervision of [[ESCO]] International GmbH/Austria. The *Acceptance Test*s shall comprise of a functional test and tests of individual parts of the equipment and/or units of the LST (AC & DHW). The test procedure of the *Acceptance Test*s will be worked out jointly with [[ESCO]] and the *Installer*. [[CLIENT]] will be timely invited to be a witness of the Acceptance test.

After the *Acceptance Test*, equipment or parts which have not met the guaranteed values shall be re-calibrated to improve the performance of the LST. In the event that the guaranteed Monthly Yields as per Table 1. are not met due to reasons outside [[ESCO]] control (weather conditions, etc.), it is agreed that *Acceptance Test*s shall be repeated, but the 1. *Acceptance Certificate* shall be not withheld.

The *Acceptance Certificate* for the LST shall be issued to [[ESCO]] and signed by the *Installer* and as a witness by [[CLIENT]] after the Performance Tests are carried out. Please refer to the drafted Forms as per Annex VIII

c) Consumption of produced Energy (heat ,cold)

The stipulated solar yields mentioned are the average energy outputs over a whole year.
The cooling production XXXX kWh/day is the maximum cooling energy output for one day which can be reached by the *Solar Thermal Plant*. If the [[CLIENT]] needs less cooling energy than this maximum output the mentioned average energy output over a whole year as mentioned in the table could not be reached because it has to be considered that on some days you have surplus of usable solar energy. The *Metering Equipment*s are installed as per technical specification and stipulated in the flow Diagrams.

Even if production during maximum solar radiation- very sunny days- is optimal , or in periods with minimum consumption [[CLIENT]] will also utilize the entire solar energy production.

d) Optimizing, Final Performance Data

The Optimizing Period of 3 years for the LST for [[CLIENT]] will start after the completion of the *Solar Thermal Plant* and the full Operation of the LST. All the performance values will be defined jointly with [[CLIENT]] and [[ESCO]] during the optimising period.
It is mutually agreed that Optimizing Period of another 3 years can be extended if the agreed and stipulated Performance Values are not reached in order to enable [[ESCO]] to make alteration on the *Solar Thermal Plant*, to gain the optimum output of Energy. [[ESCO]] can decide if is necessary to carry out these alteration.

[[CLIENT]] shall issue the Final *Acceptance Certificate* to [[ESCO]] after the 3 years period, and provided that all the stipulated guaranteed data as specified above are met.

The Final *Acceptance Certificate* shall specify all relevant parameters of the LST as stipulated by [[ESCO]].

All forms of protocols, test reports and other documentation during commissioning can be provided by [[ESCO]] upon request to [[CLIENT]]. Samples see Annex VIII.

Annex VIII

VDI 2067

ICS 91.140.01 VDI-RICHTLINIEN September 2000

VEREIN DEUTSCHER INGENIEURE

Wirtschaftlichkeit gebäudetechnischer Anlagen Grundlagen und Kostenberechnung

Economic efficiency of building installations Fundamentals and economic calculation

VDI 2067

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Die deutsche Version dieser Richtlinie ist verbindlich.

No guarantee can be given with respect to the English translation. The German version of this guideline shall be taken as authoritative.

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VDI-Handbuch Wärme-/Heiztechnik

Annex IX

TARIFF

Fees/Charges

The enclosed Tariffs stipulates the fees and charges invoiced to [[CLIENT]] for energy generated by the *Solar Thermal Plant* and to be utilized by [[CLIENT]] at the takeover points (interfaces) and measured by the Heat Meters installed at the interfaces. The parameters (Temperature °C and Flow m³) will be stipulated and agreed upon with [[CLIENT]] and [[ESCO]] during project period and/or optimizing. Please refer to the Consumption Calculation Methodology for LST.

Table 1. Summary of Consumption *Fee*s and Capacity Charges

Energy service, ESCo Cost Scheme TARIFF

Customer:
Project:
Prize Basis:
Installed Capacity:

Date:

TYPE	Production/Consumption		Fees/kWh	Fees/Charges with MINIMUM consumption		Total/year	NOTES
	min. [kWh]	max. [kWh]	[/kWh]	øConsumption Fee [/year]	øCapacity Charges [/year]	[ ]	
COOLING							
HOT WATER							
TOTAL							

ESCo Tariff

Summary of annual consumption fees and capacity charges will be calculated according to the actual prevailing values as follows:

Monthly consumption x electric tariffs for AC (published ¼ year by SP), or gas tariffs for DHW (published frequently by City Gas) + capacity charge = Sum Month 1

The total sum (Annual Account) will be compensated by the estimated advance payment paid by [[CLIENT]] of the year xxxx. The difference, if positive will be considered for the coming year estimated advance payment and is payable to an agreed period to [[ESCO]].

The monthly advance payment of the consumption fee and the capacity charges for the forthcoming year will be calculated by the total of the fees and charges from previous year divided by 12.

These *Fee*s/Charges will be adjusted semiannually according to below set out formulas:

P_{xxxx} shall mean the prices/values of fee prevailing in the year xxxx

P_{2009} shall mean the prices/values of fee prevailing in the year 2009

CPI_{xxxx} shall mean the prices/values of the Consumer Price Index published by [COUNTRY]Department of Statistics for the year xxxx

CPI_{2009} shall mean the prices/values of the Consumer Price Index published by [COUNTRY] Department of Statistics for the year 2009

ET_{xxxx} or GT_{xxxx} shall mean the prices/values of the Electric Tariff or Gas Tariff published by [COUNTRY UTILITY] , quarterly for the year xxxx

ET_{2009} or GT_{2009} shall mean the prices/values of the Electric Tariff published by [COUNTRY UTILITY] or Gas Tariff published by City Gas respectively, quarterly for the year 2009

Consumption *Fee*s:

$P_{ET\ xxxx} = P_{2009} \times ET_{xxxx}/ET_{2009}$

$P_{GT\ xxxx} = P_{2009} \times GT_{xxxx}/GT_{2009}$

Capacity Charges:

$P_{ET\ xxxx} = P_{2009} \times CPI_{xxxx}/CPI_{2009}$

a. **Example Equation:** (for electricity)

2009 Consumption *Fee* $P_{2009} = 243.908 \times 0{,}22_{2009}/0{,}25_{2008} = 214{,}639$

2009 Capacity Charges $\underline{P_{2009} = 369{,}740 \times 100_{2009}/ 99{,}4_{2008} = 371{,}971}$

Total 2008 613,648 “$, €, etc” Total 2009 586,610

b. **Example Table – Historical Escalation:** (~ annual changes from the year before)

YEAR	Electric Tariff ET Ø (%)	Gas Tariff GT Ø (%)	Consumer Prices Index CPI (%)
2004	- 6	+/- 0	+ 1,4
2005	+ 20	+ 15	+ 0,5
2006	+ 16	+ 10	+ 1,0
2007-09	Energy prices fall due to international economic crises		
2009	Energy prices ~ + 0,5 % of 2006 Energy prices		

Energy Consumption Calculation Methodology for LST System

The following Table 2 and Table 3 summarize the key figures which will be used for the energy usage calculation. The metering devices will collect the data on an hourly basis and tabulate the performance for a day. The information collected will be compared to a baseline and the differences from the baseline will indicate the performance of the LST system. The baseline for both Table 2 and 3 are derived accordingly to the load requirements as agreed by [[CLIENT]].

c. Chiller System

For the chiller system, two key metering devices, installed at the interfaces, namely temperature sensors and the flow rate meter (*Metering Equipment*) will be used to provide information on the supplied chilled water from solar to TRANE main chilled water header. The baseline minimum of 5˚C and a flow rate of chilled water of 254m^3/hr will give a refrigerant capacity of 420 t_{ref}

d. DHW System

A heat meter (*Metering Equipment*) will be used and placed at the outlet of the domestic hot water tank to determine the amount of heat energy being taken up by the campus load. A minimum consumption per day of 15m^3 at 55˚C is granted by [[CLIENT]] and can be alternatively monitored using two temperature sensors and 1 flow rate meter.

Table 2. Proposed Hourly Data Comparison for Chiller System

	Electric Power Use by Chiller System (kW)	Incoming CHW Temperature from Trane (˚C)	Delta Temperature by Solar Chiller (˚C)	Flow Rate (m^3/hr)	Cooling Tonnage Produced (t_{ref})	Chiller Efficiency (kW/t_{ref})
Baseline	142.8	16	5	254	>420	0.34
Measured 1st hour						
Measured X hour						
Total difference from Base						

Table 3. Proposed Hourly Data Comparison for DHW System

	Electric Energy use by DHW System (kWh/hr)	Incoming PUB Temperature (˚C)	Supply Temperature after Heat Exchanged (˚C)	Flow Rate (m^3/hr)	Total Supply of Hot Water produced (m^3)
Baseline	0.273+B*	20	55	5	15
Measured 1st hour					
Measured X hour					
Total Difference from Base					

*0.273kw is the power requirement for distribution of energy to the hot water storage tank, while B will be gas boiler, which will only be activated if there is insufficient heat energy.

Use of [[CLIENT]] Utilities

This *Agreement* is based on [[CLIENT]] providing the following electricity and water free of charge.

e. Power Consumption

The assumed power consumption (electricity) of the entire *Solar Thermal Plant* is ~15 % of the total solar production (solar yield). The actual power consumption for LST will be recorded in the power meters, which are located at the control panels.

Specific Energy demand to operate the LST: (LST operating at optimum under full load)

Cooling: 0, 3276 kW/t_{ref}

DHW: 1, 2589 kW/m^3

f. Water Consumption

The estimated water consumption for re-cooling of the cooling tower of the *Solar Thermal Plant* is 8 – 10 l/kWh cooling production

Consumption in excess of these figures materially affects the cost effectiveness of the system. If on an annual basis the consumption is more than 10% higher than the figures set out above and in addition the consumption of [[CLIENT]] of energy has been in line with [[CLIENT]]'s user profile (as attached), then such additional consumption will be calculated at prevailing rates and without additional charges or penalties deducted from the fees and any payments due.

g. List of estimated power consumption of LST equipment

DESCRIPTION	LOCATION	POWER REQUIRED (KW)	actual Power for cooling, hot water in operation (kW)	Estimate Operating Hours (Hrs)	Estimated Energy Consumption	LOADING (Amp)	STARTING CURRENT (Amp)	POWER SUPPLY
Pump 1 - Solar Circuit	Chiller plant room							
Pump 2 - Heat Medium	Chiller plant room							
Pump 3 - Chilled Water	Chiller plant room							
Pump 4 - Cooling Tower	Chiller plant room							
Pump 5 - Refilling	Chiller plant room							
Pump 6 - Domestic Hot Water	Domestic hotwater plant room							
Pump Unit 7 - Domestic Hot Water	Domestic hotwater plant room							
Pump Unit 8 - DHW back up	Domestic hotwater plant room							
Pump Unit 9 - DHW back up	Domestic hotwater plant room							
Absorption Chiller	Chiller plant room							
Gasboiler	Domestic hotwater plant room							
Cooling Tower Shiwan	Roof Educational Block 1							

ESTIMATED POWER REQUIREMENT		
∑ for Cooling	kW/T_{ref}	0,3276
∑ for DHW	kW/m^3	1,2589

∑ kWh/d 690

PRECONDITION are: Chiller capacity
DHW capacity
Climat Condition as per NASA statistic.

Estimated Power Requirement

Annex X

DEED

***Deed* with xxx to be attached**

Annex XI

FORMS OF

CERTIFICATES, CHECKLISTS

Acceptance Certificate

ACCEPTANCE CERTIFICATE

Issued by: ____________________ Witnessed by: ____________________

____________________ ____________________

Place: ____________________ Date: ____________________

____

Applying Standards/Specification: ____________________

____

concerning

____

(Description of Plant and Agreement Nr, drawing Nr:, etc.)

PERFORMACE DATA:

REMARKS: ____________________

The Large Solar Thermal as tested fulfil the performance as set out in the Agreement and is ready for operation, the optimising of the LST will be performed until ____________ This optimising will only be carried out by solar specialists and requires a full internet access as mentioned in the Agreement.

Finish date of installation: ____________________

Acceptance Certificate (Draft) 1

Inspection Certificate

Inspection Certificate

In Accordance with EN – Standard Nr. 12977 – 1

ACTION:	BUILDING UNIT:

Company Name:			
Address:.			
		Tel.	

Material Overview	Product	Type	Details		Copper	Steel	Stainless steel	Brass	Other Material
Collector									
Piping									
Heat Exchanger									
Hot Water Cylinder			capacity	L					
Buffer Tank			capacity	L					
Fittings			capacity	L					
Expansion Vessel			capacity	L					

Plant Settings (* = Control Unit Input)		Type		Max. Temperature	Temperature Difference		Hysteresis = Δ T (off)	
User 1* – eg. Domestic Hot Water Tank				°C	K			K
User 2* – eg. Buffer Tank				°C	K			K
User 3* – eg. Buffer Tank				°C	K			K
User 4* – eg. Swimming Pool				°C	K			K
Actual Collector temp.		°C	Cooling function (from)					°C
Actual Outside temp.		°C	Through-flow		design:	l/Std	actual:	l/Std
System Pressure at	°C	bar	PrePressure – Expansion Vessel		design:	bar	actual:	bar

Thermal Fluid					
Optical Assessment	☐ clear ☐ brown ☐ black ☐ cloudy				
Make/Type		Min. Value	Actual		☐ flushed
Capacity	Litre pH-value				☐ filtered
Mix ratio	% Antifreeze for	°C	°C		☐ airbleeded

General Plant Assessment			
Collectors clean	☐ ok	Pump operation tested	☐ ok
Collectors securely mounted	☐ ok	Temp. sensors displaying realistic values	☐ ok
No condensation inside collector	☐ ok	Plant is properly earthed	☐ ok
One-way valves	☐ ok	Spare thermal fluid available	☐ ok
Domestic hot water mixer	☐ ok	Anode checked	☐ ok

Heat Meter Nr.		Heat Meter Nr.		Heat Meter Nr.	

User has been trained	☐ Yes ☐ No	Maintenance contract	☐ Yes ☐ No
Maintenance Inspection	☐ annually ☐ every 2 years :		

Testet by		Date		Customer's Signature

Start-Up Checklist

CHECK LIST FOR START UP

LARGE SOLAR THERMAL (LST)

Contract NR: ____________ Client Representative: ____________

Location/Building: ____________ Representative: ____________

Date: ____________ Time: ____________

	DATA & ACTION							
	Parameter	check	clean	repaired	Date	until	REMARKS	Signature: L SOLID
Check the HYDRAULIC SYSTEM	(Priliminary and secondary circuit) for							
1 Leakage								
2 Pressure								
3 Antifreeze								
4 pH-Value								
5 Optical check								
6 Insulation								
7 Fixing/Installation								
8 Expansion system(prepressure)								
9 Bleeding								
10 Security systems (safety valves)								

Client ____________ ____________ ____________

PAGE 1

Annex XII

BEST PRACTICE

BEST PRACTICE

Solar.nahwaerme Energiecontracting GmbH;

Graz (Austria)

Project "WASSERWERK ANDRITZ"

Supported by INTELLIGENT ENERGY EUROPE

EXECUTIVE SUMMARY

Solar.nahwaerme Energiecontracting Gmbh is a subsidiary company of nahwaerme.at Energiecontracting GmbH, which is an Energy services company. It was established and operates in collaboration with local partners, systems based on renewable energy sources. In the project "Wasserwerk Andritz" a large scale solar thermal plant was erected on the ground of the local water supplier. The system supports the local heating system (LH) of the office buildings of the local water utility. The surplus heat is fed into the district heating grid (DH) from the city of Graz. With the installed high temperature (HT) flat plate collectors, the necessary temperatures for district heating supply can be achieved. On the local water conservation area, enough open space was available for construction of the plant.

GBE FACTORY MODEL

The free available area of the water conservation area zone is used for the construction of the solar field.

The installed solar thermal system covers about 40 % of the heating energy which is needed for the local office buildings. The large part of the heat production is fed into the district heating grid.

QUICK FACTS

LOCATION: Wasserwerkgasse 9-11; A-8045 Graz

PLANT SIZE: 3,855 sqm

TECHNOLOGY/RES: Solar thermal HT collectors

SITE OWNERSHIP: Holding Graz AG

INVESTOR: Solar.nahwaerme Energiecontracting GmbH

PROJECT COST: 1.57 Mio. €

DESIGN AND CONSTRUCTION

The solar plant feeds in over a heat exchanger into a storage tank with 62 m³. As a matter of priority which serves as an inventory heat storage tank. In the case that the solar plant cannot deliver energy, the district heating as a conventional source of energy provides the storage tank. Furthermore it is planned to install a heat pump this year, which will operate, if the temperatures of the collectors fall below a decent temperature, because this temperature is still high enough for reaching a satisfying COP of the heat pump. Starting out from the storage tank the existing objects as well as the new building are provided with warmth. If there is a surplus of solar energy, i.e. storage tank is fully loaded and can take no more warmth energy; the solar energy will be fed directly into the district heating net of Graz. All collectors are free mounted on the area of "Wasserwerke Andritz". This large-scale solar plant demonstrates the commitment of the city of Graz to renewable energies and the protection of the environment. The plant is the 4th solar system which is integrated into the district heating system of Graz.

TECHNICAL DETAILS:

TOTAL SURFACE: 3,855 sqm

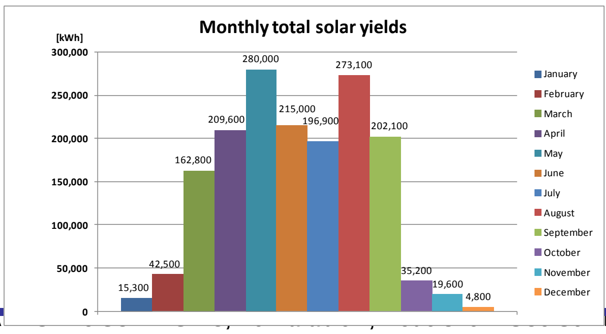
NUMBER of thermal collectors: 270

HEAT STORAGE: 62 m³

TOTAL solar yield: 1,657 MWh/year

SPECIFIC solar yield: 430 kWh/m²$_{BRUTTO}$*a

MONTHLY TOTAL ENERGY GENERATED



FEED-IN-TARIFF AND OTHER BENEFITS

PARAMETERS OF INSTALLATION:

Typology and Profitability of equipment:

Installation: 2nd QT 2009

Capacity [kW$_{therm}$]: 2,062.4

<u>Feed-in-Tariff :</u>

- LH: 54,352 €/MWh
  - Demand rate LH: 204,6 €/month
- DH

BUSINESS PLAN

CONSUMPTION PARAMETERS

See feed -in-tariffs

PARAMETERS OF ECONOMIC'S SIMULATION SALE

Interest rate: 4.0%

Grants: 550,000 €

Maintenance and insurance cost: app. € 1.000

Depreciation period: 25 years

System's Depreciation charge: 4 %

Discount Rate:

- LH: 0%
- DH: 17.3 % (based on the winter tariff)

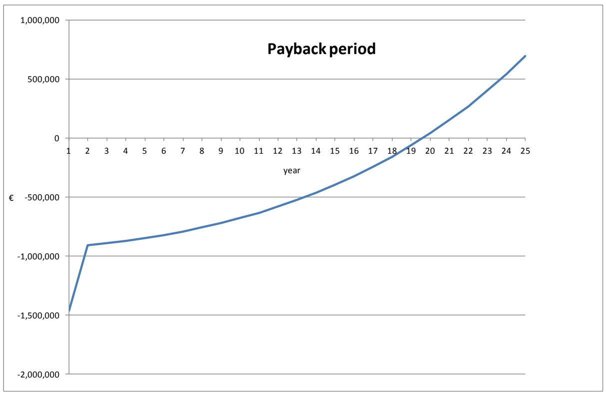
Income tax: 25 %

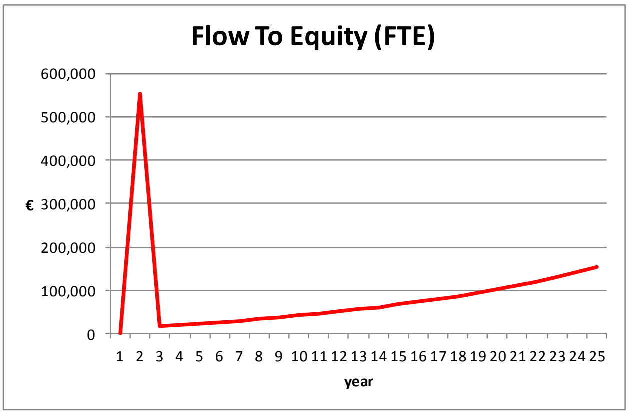
SIMULATION'S TECHNICALS PARAMETERS

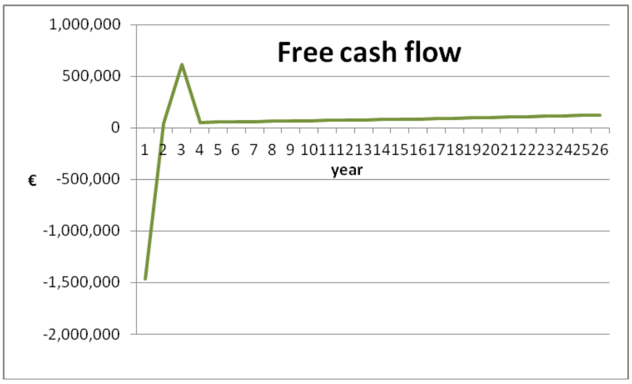
District heating net: 84.2 % of total solar energy produced

Local heating demand: 15.8 of total solar energy produced

Solar fraction: 40 % of the local heat demand







IRR after 25 years: 8.7 %

LESSONS LEARNED

This solar thermal system shows us following points:

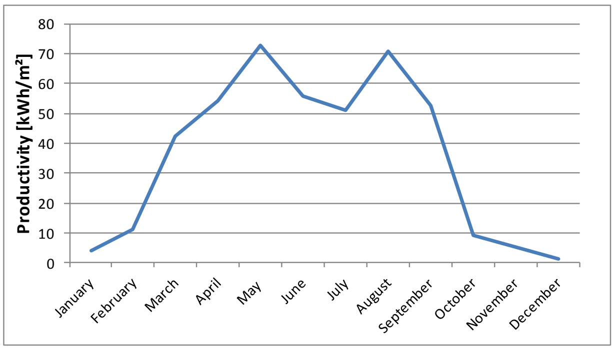
- Efficiency of large solar thermal applications
- Application of an ESCO model in this field of RES
- Existing economy (also with a 17.3% lower feed in tariff compared to conventional heat sources, which feed into the district heating grid)
- Possibility of solar district heating supply

This example shows the possible use of large solar thermal plants. Due to higher feed-in tariffs in an industrial area, the payback time could be significantly reduced.

ENVIRONMENTAL & ECONOMIC SUSTAINABILITY

The measured total solar yields are shown in the table below.

	Total solar production	Total solar production
	[kWh/month]	[kWh/brutto m² coll.]
January	15,300	4.0
February	42,500	11.0
March	162,800	42.2
April	209,600	54.4
May	280,000	72.6
June	215,000	55.8
July	196,900	51.1
August	273,100	70.8
September	202,100	52.4
October	35,200	9.1
November	19,600	5.1
December	4,800	1.2
SUM	1,656,900	429.8



Total monthly trend analysis over the year:

Solar thermal energy is CO2-free and therefore environmentally friendly. In determining the CO2 savings following substituted heat sources were considered: Coal power plant, natural gas power plant, gas heating plant, industrial surplus heat. The impact of the district heat amounts to 99.206 kg CO2/MWh.

Contribution to the environment		
CO_2 Savings	164	[tons CO2/year]

BEST PRACTICE

Caixa Geral de Depósitos;

Lisbon (Portugal)

EXECUTIVE SUMMARY

In Lisbon a large office building of the bank Caixa Geral de Depósitos (CGD) are supported by solar heat and cold. The collector area is installed in roof of the office building. The office building has 17 floors with an office space of 100,000 m². During the working time 6,000 employed persons are permanently in the building. The generated energy is used to power an absorption chiller. Furthermore, the energy is used for the reheating system of the ventilation appliances as well as contributing to the heating of hot water.

Caixa Geral de Depositos

Sales & purchase Agreement

On the one side CGD wished to install an economical RES to save energy, on the other side the architecture and appearance of the building had to be considered. Because of the location the only available useful area is the roof of the building. The design of the collectors could be optimal combined with the existing blue tile roof. With the integration of the system the existing energy distribution system has been optimized, and further energy savings achieved.

Thanks to the system app. 45% of the domestic hot water demand, 15 % of reheating

QUICK FACTS

LOCATION: Rua Arco do Cego, Piso 1; Lisbon Portugal

PLANT SIZE: 1,579 sqm

TECHNOLOGY/RES: Solar thermal HT collectors

SITE OWNERSHIP: Caixa Geral de Depósitos

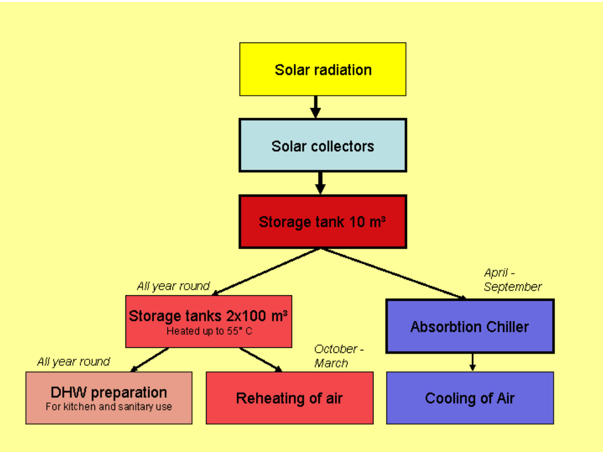
INVESTOR: Caixa Geral de Depósitos

PROJECT COST: 1,040,000 €

DESIGN AND CONSTRUCTION

The solar energy is for building cooling and air-conditioning in the CGD building, in the months of April to September. Extra thermal energy from the plant may also be used to heat up the water coming from the existing 100 m³ tanks in the basement and to replace the electric energy used by the heat pumps to cover the heat needs for DHW and reheating the air. The solar energy is used for heating purposes mainly in the months of October to March. The energy output and current system data can be displayed on a monitor in the CGD offices as well as online, adding visibility and control of the energy output to the solar solution.

Priority: 1. DHW, 2. reheating, 3. cooling



Flow chart on energy supply

TECHNICAL DETAILS:

TOTAL SURFACE: 1,579 sqm

NUMBER of thermal collectors: app. 112

SOLAR HEAT STORAGE: 10 m³

TOTAL solar yield hot: 978.2 MWh/year

- *Solar yield cold (cooling): 263 MWh/year*
- *Solar yield reheating: 202.6 MWh/year*
- *Solar yield DHW: 400 MWh/year*

*SPECIFIC solar yield hot: ~ 619.5 kWh/m²$_{BRUTTO}$*a*

PARAMETERS OF INSTALLATION

Typology and Profitability of equipment:

Installation: 1th QT 2008

Capacity [kW_{therm}]: 845

Capacity Absorption Chiller: 545 kW

ENERGY DISTRIBUTION

The total produced solar thermal energy is used locally.

Substituted Energy

Form of energy: electricity (heat pump and compression chiller)

Price electricity: 68 [€/MWh]

Solar thermal production: 978,2 [MWh/year]

Solar coverage

The exact total consumption of the building are not known. Thus, the solar coverage can be roughly estimated.

Solar coverage:

BUSINESS PLAN

PARAMETERS OF ECONOMIC'S SIMULATION SALE

Interest rate: 6.0%

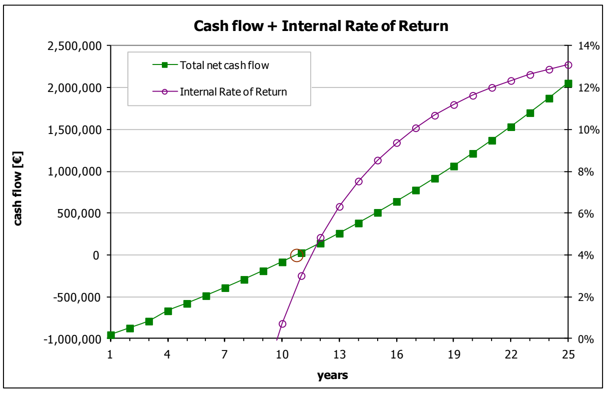
Grants: 0 €

Maintenance and insurance cost: € 6000/year

Depreciation period: 25 years

System's Depreciation charge: 4 %

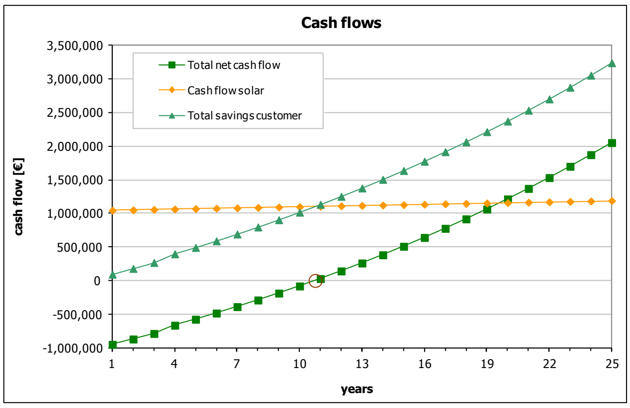
Cost increase fuel: 6 %



Payback time: 10.8 years

IRR after 25 years: 13.1 %

A comparison of the two cash flows for solar



LESSONS LEARNT

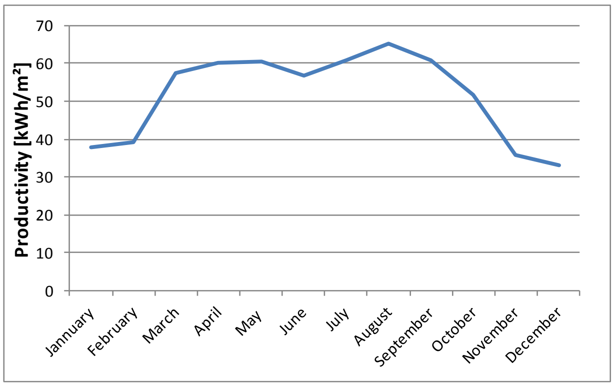
This solar thermal system shows us following points:

- Efficiency of a combined solar thermal system - cooling & heating
- The peak of solar radiation and the peak demand of solar cooling match perfectly
- The solar yield depends strongly on the required temperature level of the application.
- Provided energy is often limited by available collector area.
- Often, a optimization of the existing system is possible by the integration of RES.
- Solar cooling cuts off electricity peaks and saves the most expensive electricity.
- Absorption Chillers have a long life time (> 25 years).
- Cooling load reduction (external loads) because of the mounted collectors on/in roof.
- Good economy also without grants.
- Easy transferability to other office buildings.

ENVIRONMENTAL & ECONOMIC SUSTAINABILITY

The measured total solar yields are shown in the table below.

	Total solar production [kWh/month]	Total solar production [kWh/brutto m² coll.]
January	59,938	38.0
February	61,594	39.0
March	90,721	57.5
April	94,736	60.0
May	95,581	60.5
June	89,823	56.9
July	96,277	61.0
August	103,228	65.4
September	96,010	60.8
October	81,676	51.7
November	56,228	35.6
December	52,434	33.2
SUM	978,246	619.5



Total monthly trend analysis on the year

Solar thermal energy is CO2-free and therefore environmentally friendly. In determining the CO2 savings following substituted heat source are considered: electricity. The impact of electricity amounts to 417 kg CO2/MWh in Portugal.

Contribution to the environment		
CO_2 Savings	**407,928**	[tons CO2/year]

Through this investment the company is less dependent on electricity and unexpected energy

CURRIDGE PRIMARY SCHOOL

BERKSHIRE, UK

MOTIVATION

Curridge Primary School is situated in Curridge, Thatcham, Berkshire. The building is a small primary school of approximately 100 pupils with the original building around 100 years old, there have been extensions added since then. The building is brick built construction, the original part being solid wall. The building _oor area is something

less than 1000 sq.m. The existing oil _red boilers were no longer serviceable and required an alternative solution in a short timescale, either like for like replacements or a biomass fuelled boiler. The local renewable energy agency TV Energy provided a feasibility study to determine whether biomass boiler supplied heat was a viable option. It was able to access funding from the regional development agency (SEEDA) to part fund the boiler cost and o_er to deliver woodfuel to the boiler as part of ist existing operation, and so the ESCo idea began.

ESCo MEASURES

The heating system is standard radiators throughout the building originally supplied with hot water generated by two oil _red boilers. The existing radiators are now supplied by a single biomass boiler, with an additional heat loop connected to two external pre-fabricated classrooms which were previously heated using individual LPG fuelled heater units. There were no additional measures undertaken with the exception of connecting the two external classrooms to the biomass heating system. The investment cost was approximately £60,000 (€67,500), of which £20,000 (€22,500) was provided as a grant by SEEDA. The school through the local authority provided the equivalent sum of capital as would have been required to provide a like-for-like replacement of the oil boilers.

ACHIEVEMENTS

There were no appreciable di_erences in the heat consumption before and after the ESCo operation as no other measures besides the extension of the biomass heat loop were carried out. The project required a number of visits to iron out initial teething problems. It was important that the client at the start of the project understood that even though the cost of woodchip is less than the alternative heating fuel, the overall cost of operation of the boiler will be similar to the previous system. This is in order for the ESCo to recover the investment cost of the equipment through charges for heat.

The school is very pleased with the boiler and ESCo arrangement, once initial teething problems were overcome. The ESCo is happy with the operation, but it should be understood that this type of project with a small heat load requires signi_cant grant funding in order for the ESCo to be _nancially viable.[1]

HEAT SUPPLY FOR A SCHOOL CENTRE IN BAVARIA

MARKTREDWITZ, GERMANY

MOTIVATION

The municipality of Marktredwitz and the district administration operate several schools plus associated facilities such as a sports hall. Marktredwitz is a small town in Eastern Bavaria. The building complex used to be heated very ine_ciently with old gas boilers that had to be replaced due to high total heating costs.

The contractor KEWOG Energie & Dienste performed a _rst analysis and determined the total annual heat demand of the buildings to be 3500 MWh, the primary energy demand being 4000 MWh. The analysis also revealed an energy saving potential of 33 %.

ESCo MEASURES

This project is one of the few contracting projects in Germany that is in full compliance with international ESCo de_nitions. It combines regular heat delivery contracting with guaranteed heat savings.

Client and contractor decided to implement an energy performance contract based upon the heat demand baseline of 3500 MWh. KEWOG applied its Energy Balance System that includes remote controlling, optimized heat production control and the installation of e_cient pumps and radiator regulation. The contractor guaranteed energy savings of 25 % against the baseline. If these savings are not achieved the contractor pays back additional fuel costs.

In addition, a new wood chip boiler with a capacity of 1000 kW was installed. An existing gas boiler (1750 kW) was refurbished and is used as peak load system. The existing fossil fuel systems are often used to cover peak loads or as emergency systems in ESCo projects in Germany. Biomass boilers are in most cases used to cover the base load only.

Besides the new boiler, wood chip storage (250 m3) and a heat grid were installed.

Since 2007, the school centre is supplied with renewable heat derived from regionally produced wood chips.

[1] http://www.biosolesco.org/best_practice/Best_practice.pdf

ACHIEVEMENTS

In total, around € 1 million was invested of which around 20 % were the contractors' own fund, the rest being covered by bank loans. As it is common in PPP projects in Germany the contractor sold the claims to the bank, while the customer is committed to pay the bank without conditions. This way, very favourable loan conditions can be achieved. The contract duration for this project was set at 15 years. During this time the client pays a basic price that covers the investment and labour costs. In addition, the client pays for the heat amounts actually consumed.

Until now, the guaranteed heat savings are achieved. The client's total heat costs (incl. capital costs) are reduced, even when compared to mere fuel costs before the project. Usually projects including the installation of new heating systems only achieve cost savings compared to an alternative project implemented by the client themselves.[2]

[2] http://www.biosolesco.org/best_practice/Best_practice.pdf