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"ST-ESCOs"

Development of pilot Solar Thermal Energy Service Companies (ST-ESCOs) with high replication potential.

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ST-ESCOs Background Study

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<u>Abbreviations used:</u>

ESCO: Energy Service Company

ST-ESCO: Solar Thermal ESCO

EPC: Energy Performance Contracting

TPF: Third Party Financing

IRR: Internal Rate of Return

1 Existing experience

1.1 Existing experience in Hellas

Up to now only few attempts have been made from someone to play the role of an ESCO for the application of TPF schemes. These attempts concerned Solar Thermal applications along with upgrading of thermal installations (piping insulation, heat exchangers, etc).

In two of these attempts (industrial applications) CRES was involved as described below:

- 1st case (Achaia Claus - winery): CRES was responsible for the telemonitoring equipment design / procurement, as well as for issuing the «solar bills». For this project the role of the ESCO was played by the Solar System manufacturer (SOLE LTD).
- 2nd case (Mevgal- dairy): CRES played the role of the ESCO.

Apart from CRES, only two companies (SOLE LTD and SOL ENERGY HELLAS Inc.) have made efforts in order to act as ESCOs. The second company has performed only one project (in a hotel) with the TPF method and several others with the GRS method (Guaranteed Solar Results).

The contracts of the first two projects (industrial) were in the form of Build, Own, Operate and Transfer (BOOT) while the third one (hotel) was in the form of Build, Operate and Transfer (BOT).

In the case of GRS the supplier of the solar installations provides the user with a bank guarantee linked with the monitored performance of the systems.

The structure of the existing contracts is the following:

- For the two installations (industry and hotel) for which the System providers / manufacturers played the role of the ESCO, the user paid no money for the installation of the systems, but paid the manufacturer the amount of energy supplied by the system, based on a fixed rate per kWh decided upon before the installation of the system. For the industrial project, the Centre for Renewable Energy Sources (CRES), undertook the monitoring of the system, which determined the energy supplied by the system, while for the hotel the system performance was monitored by the installer. When the user paid the initial investment of the system back, the system became the exclusive property of the user.

- For the industrial project, where CRES played the role of the ESCO, the structure of the contract was based on the provisions of the draft law *"TPF of Energy Investments for Energy Saving, Cogeneration & Independent Generation of Electrical or/and Thermal Energy from RES"*. The main elements of the project and contract are presented in Annex I. Information about the plant is given in the paragraph “Case studies”.

1.2 Existing experience in Austria

In Austria Solar Thermal Energy Service contracts are often combined with energy efficiency measures and/or comprehensive refurbishment (e.g. implemented with EPC models).

In the last 5 years the Austrian Energy Performance Contracting (EPC) and Third Party Financing (TPF) market has seen a quick development (Seefeldt 2003). To date the energy efficiency of about 600 to 700 buildings has been improved via EPC, as compared to almost zero in 1998; these buildings represent roughly 4-6 % of all service sector buildings. Another 300 to 400 federal buildings (about 50 % of total floor area) will get an EPC contract in the next 3 years (Leutgöb 2003). To this day a vast potential is still untapped for energy service in general, and energy performance contracting in particular. In 2001 the Austrian Energy Agency did a rough estimation of the Austrian EPC market and the market volume for the sector of private and public service is estimated as follows: Based on the assumption that around 50 % of the building stock is suitable for implementation of EPC and TPF concepts, the estimated investment volume amounts to about 300 million €. This correlates with an estimated energy cost savings of around 50-60 million € per year and associated CO2 reductions of 600.000 to 700.000 t per year.

In Austria, EPC and TPF are well established instruments to increase the energy efficiency in buildings as the framework conditions are suitable and the demand for and the supply of EPC and TPF services is growing and is clearly also an opportunity for ST ESCOs. The potential encompasses different building categories e.g. federal buildings, county buildings, municipal buildings, hospitals as well as private service buildings. The Austrian Energy Agency states “Austria is – together with Germany – the EPC pioneer in Europe” (Leutgöb 2003). Especially in the last years a further development of contracting to a comprehensive energy service (also including solar thermal technology) was reached. Innovative technologies and renewable energies, especially solar thermal plants, are integrated and a pooling of different buildings takes place.

Up to now there are about 40 ESCOs in Austria and some of them offer also solar thermal plants in combination with energy efficiency measures and comprehensive refurbishments. In recent years the role of ESCOs has become even more central in the delivery of energy services in the new liberalised energy market. The main customers and driving forces are the federal building administration, a few local governments in large cities (Graz, Salzburg) and, surprisingly, housing associations and some small and medium-sized municipalities. Currently private commercial buildings are not typical EPC or TPF customers. The Austrian ESCOs active on the EPC and TPF market have developed from different starting positions (Task X country report Austria):

- Some international companies from the building technology industries have expanded into the ESCO business
- Few civil engineers that cover the energy saving planning and management aspect of the business and engage subcontractors for the operative work
- A limited number of utilities has developed towards the energy service concept and is offering ESCO services

All these emerging ESCOs are also potential future ST ESCOs.

In Austria the regional and the national energy agencies played a crucial role in the development of energy services, small ESCOs and also ST ESCOs. The EPC projects in small and medium-sized municipalities have been supported by regional programs, e.g. in Styria, Upper Austria, and Tyrol. The increase of the Austrian EPC market is based mainly on increased know-how: energy agencies at the national, regional and local level have acted as know-how carriers and through action in public buildings drew the attention of businesses to the end-use energy efficiency market niche (Seefeldt 2003). Energy agencies play also a major role when it comes to market preparation by means of campaigns and awareness raising for solar thermal plants (small plants as well as large scale installations) and energy services. Furthermore they play a crucial role in the market development as they are seen as neutral advisors. Also the development of quality criteria and certification is building trust in the application of EPC and TPF.

At the beginning of 2003 the program “Ecofacility” by the Federal Ministry for Agriculture, Forestry, Environment and Water Management in the frame of klima:aktiv has been started that targets private commercial and service buildings (e.g. office buildings, shopping centres, hotels, etc.) through EPC, planning and comprehensive service packages. The klima:aktiv program “solarwärme” is focussed on the support of the integration of solar thermal energy.(Details about the programmes of the federal government ,known as klima:aktiv programmes, exist in Annex IV).

All these features place Austria in the premier league of ESCO and also ST ESCO developments in Europe.

1.3 Existing experience in Spain

In Spain, there are basically two types of Energy Services “contracting”-models which are actually being used:

<u>Third Party Financing for heat and/or electricity delivery</u> that was used by I.D.A.E. (Institute for Diversification and Energy Efficiency) as a financial support
<u>Energy Performance Contracting, which is working for co-generating plants.</u>

However until now, just a couple of attempts for ST-ESCOs are running from some companies that play the role of an ESCO for the application of TPF schemes.
At the beginning of ST-ESCOS European Project, there was not a large number of initiates of a ST-ESCOs or similar project in Spain, although there were several TPF (Third Party Financing) support by the Industry Department Grants programme, which have been operating for the last few years.

Some important Enterprises have been contacted in the recent months about their participation in ST-ESCOs formulas and none positive response is obtained yet. Their arguments are related to the different barriers and uncertainties this project model means.

However, some solar thermal collector fabricators have positively stated that could be interesting to lead a ST-ESCOs project, in order that the beneficiaries to obtain some benefits and after a few years also to be owners of the facility., as well as they uses these singular experiences in order to promote their own companies. Fabricators are looking for new model to increase their sells.

ARGEM and the rest of ST_ESCOs project partners, AIGUASOL and APERCA are are actually trying to find out some more useful experiences.

Now it is presented below a couple of facilities which are working :

Sabadell Tennis Club.
Pasch and Cia. company has finalised very recently the works for the installation of a solar thermal facility in the Sabadell Tennis Club, which energy production is in average about 20 m3 per day. The company makes known that this is the first time that in Spain is realised an activity of this kind in the solar thermal field.

The facility is composed by 58 solar thermal collectors, Sunmax marl, that are occupying up to 340 square meters. The technology and products are supplied by Solel company, that is represented by Pasch y Cia. in the Spanish market.

The production of 20 m3 per day of hot water to be used to heat an Olympic swimming pool of 25 meters, as well as covering an important part of the how water needs. Annually, it produces 277.000 kWh, which will be substituting the consumption of 31.500 Nm3 of natural gas per year. The facility will avoid to issue to the atmosphere about 70.000 kg of CO2 per year.

Finally, the Hospital “de Reus” is in negotiation for a new contract.

1.4 Existing experience in Italy

In spite of a large diffusion of ESCO activities in Italy in the last two years, linked to the implementation of the legislation on the “white certificate” system (Annex VI, legislative background), few are the experiences concerning solar thermal applications.

Among the few ST-ESCO applications an example is given by a company based in the Milan area, involved in energy services provision. The company, namely Calore Energia Impianti CEI, installed in 2006 a solar thermal plant (Rivadavia) on a multi family house in Sesto San Giovanni (MI). The installation integrates a fossil fueled existing plant for the production of domestic hot water.

The installation belongs to the end user and the solar thermal plant has been included in an existing energy services contract with the ESCo. Following some characteristics of the Rivadavia system:

- the solar thermal plant is a precise request of the end users;
- the investment costs have been partially covered, 30% of the total cost, with subsidies provided by the regional government;
- on the contract there is no difference between the solar thermal plant and the conventional (existing) system for heat generation: no differences in the operation and management (ordinary and extraordinary maintenance) and in the definition of the energy price;
- the plant is guaranteed for 5 years through the Guaranteed Solar Results.

2 Barriers - Reasons for success or failure

2.1 Common Aspects

One of the main barriers for ESCOs development has been the lack of advantageous governmental policy and support measures. The proposal for a directive of the European Parliament and of the Council [Directive, 2004] on energy end-use efficiency and services and a legal push in terms of integrated energy services and energy management specific legislation in combination with mandatory national and sectoral energy consumption reduction targets would possibly take-off the EPC market especially from utilities and big companies handling a pool of potential clients. The issue of a law for ESCO business operation would clarify the operational environment.

The major problem, in terms of ESCOs market development, is identified on the magnitude and the long-term engagement of the capital required for a big energy project as well as the uncertainty regarding the expected energy savings. This uncertainty reflects technological risks as well as investment risks related to the recovery of the invested capital. Therefore, the supply of a form of State warranties or State participation in a financing network for the private sector is proposed to act as a security means. A possible way of doing this is to create a special financing group with the participation of banks, industrial companies, ESCOs and the State. An alternative and easier way is the initiation of specialized investment banks as well as commercial banks with dedicated project financing departments.

Some other barriers include:

- The missing of a legal consolidation of ESCOs. Legal and tax problems are arising from TPF implementation.
- The project financing, investment, design, construction and insurance mechanism is not well defined. No guidelines were available up to now[1].
- The direct economic benefits for the end-user become negligible if the ESCO needs high IRR or short contract duration.

Some preliminary aspects related to the reasons for success or failure could be highlighted:

[1] A Guideline with (among else) financial, contractual, legal, marketing and technical aspects is one of the deliverables of ST-ESCOs project.

- The technical solutions applied should be as simple as possible without, however, sacrificing the systems' reliability. A subsequent paragraph is dedicated to this aspect.
- The contract between the ESCO and the end-user has to be clear and simple but should cover, possibly, all aspects concerning billing, end-user consumption along the future, insurance and risks management.
- The heat supply contract should contain all technical prerequisites and conditions that are requested in order to assure a sound operation and the expected energy supply of the solar system.
- The contract must fix the minimum amount of energy that the customer is going to use. Provisions have to be taken for the case that less energy is consumed by the customer than the minimum amount that is agreed in the contract. In case of lower consumption, either a basic price or a penalty fee may be charged to the customer. In some cases it might be sensible to fix a profile for the range of the consumed energy over the year. This could be helpful for matching and optimization between the available and the consumed energy.

On the other hand, the contractor is usually asked to guarantee a minimum energy output of the plant over the period of one year. Alternatively, instead of guaranteeing a minimum energy output, the contractor might opt for guaranteeing a minimum power output of the plant. This is most reasonable if the consumption profile of the customer does not seem to be reliable, and bad effects are expected for the plant power output. In order to avoid troubles, it is recommended to define the customer's energy consumption as detailed as possible.

As regards the technical operation of the plant as it was designed, it is indispensable to exactly define all interfaces between the solar company and all other parties involved in the plant's location or operation by any kind of way. This applies not only to the technical interfaces, but also includes ownership structures of any kind.

In the heat supply contract, all kinds of ownership questions related to the solar thermal plant have to be clarified. One of the most important things to clarify is the rental circumstances (for the rent of the required collector area in the customer's or somebody else's site or building).

It is strongly recommended to sign at least a liability insurance for the plant. Sometimes, this insurance is already included in the customer's site or building which bears the solar collectors.

Another important feature is the timeframe for the solar plant; this should include the beginning of the energy delivery and the period for energy measurements consulted for the compliance with the guaranteed energy output. Also, the timeframe for a possible service and maintenance of the plant must be defined. It is a good idea to include a service and maintenance contract for the plant in order to guarantee a sound operation of the system. Not to forget, all juridical questions and responsibilities related with the installation, the operation and the ownership should be addressed in order to avoid unclear situations in the operational time of the solar system.

Financial institutions and schemes

Past successful implementations of solar thermal ESCO plants have shown that the contact with the financial institute which shall carry out the financing of the investment costs is a crucial aspect, especially when it comes to the time that elapses between the project idea and the completion of the third party financing contract. In all successful ST-ESCO examples, 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 most 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.

Lessons learned (Experience from implemented ST-ESCO projects)

This section shall only give a brief summary of the most important lessons learned in the past successful nahwaerme ST-ESCO projects and some traps to be avoided. Some of the most important faults can already be avoided by following the guidelines and remarks stated in the above sections.

- *Positive aspects of TPF project implementation*

  TPF solar thermal projects should not be seen as a rival concept against the conventional sales model. Rather, the concept of third-party financing is a good model for application where the conventional sale model is not possible from the customer’s side.

- *Tele-monitoring*

  A tele-monitoring system via modem or GSM module allows to control and optimize the plant functions and to always have current performance data of the plant as well as a data history. This system helps to increase the system performance (in terms of energy output) while reducing the costs for service and maintenance (since many tasks can be performed from the office); at the same time, possible malfunctions or bad operating conditions can be detected in advance.

- *Customer / owner topic*

  If the customer is not the same person or institution as the owner of the building which bears the solar collector field, two separated contracts have to be signed, one with each person or institution. This procedure usually results in a longer and more tedious planning period for adjusting all the technical and juridical details.

- *Energy consumption profiles*

It is important to get knowledge as exact as possible about the energy consumption profiles on part of the customer. This includes heating (and possibly cooling) loads and hot water consumption over yearly and daily variations. It is indispensable to assume a realistic load profile which accounts for both daily and seasonal changes. This data has great influence on the design and the layout of the solar system, and thus is crucial when it comes to the system efficiency and the long-term operating conditions. Another topic which is often given too little attention: the supply and return temperature levels have to be exactly defined in advance, i.e. in the heat supply contract.

- *Solar system provider*

  This is definitely the most important topic to point out: the company which provides the solar system must have the necessary experience in design, construction, installation and operation of the plant, since the entire technical and economical risk is on their side. As mentioned before, all system components must be durable in time, although exposed to high temperatures. Quality in installation, construction, operation and optimization of the system are crucial.

2.2 Specific barriers etc. for Hellas

The pure ESCO industry in Hellas may be considered negligible and stable for the present. The current legislative and financial framework in what concerns ESCOs is described in Annex II. Some barriers that are currently present in Hellas are listed below:

- The distinction of responsibilities within public authorities for the procurement, services, works and maintenance regarding the building infrastructure is not always clear.
- There is lack of institutional regulations where a public building owner is not its user and warranties regarding the cooperation between TPF experts' actors.
- There is lack of technical knowledge and expertise between the possible ST-ESCOs developers. In fact, the potentiality and the performances of large solar thermal installations are still not well known to the possible investors and to the technical actors. Therefore the perception of risk is usually too high.
- The same lack of awareness and credibility exists among the possible end-users in what concerns the economic and other benefits connected to the solar thermal plants implementation.

Moreover, two concrete formal barriers concerning the development of ST-ESCOs in Hellas are following:

1. There are difficulties in the subsidies for an ESCO agreement by the actual support measure (40% of the total cost of selected large scale solar installations is financed by the state according to the so called "Operational Program for Competitiveness- OPC"). Actually this subsidy can be provided only to an end-user and not to an ESCO. CRES is planning to make some suggestions/actions in order to overcome this difficulty in the next calls of OPC.
2. Concerning the public sector, there was, until recently, a problem with the ownership of the installation and the repayment through energy saving or

renewable energy supply bills. However, this is going to be faced with the so called "Agreements between Public-Private Sector (APPS)" that have now been introduced in the Hellenic legislative system.

Since the available experience on ST-ESCOs contracts is still limited in Hellas, only preliminary suggestions can be made about the reasons for success or failure. Some aspects on this topic are listed below:

1. One practical technical aspect learned is the following: the person responsible for the maintenance (from the ST-ESCO's side) should have relatively easy access to the plant (e.g. up to 100 km distance). Delegate this responsibility to a third person is possible only if he is an expert on solar thermal plants. The same is valid for the operational responsibility: count on a third person (e.g. a technician from the End-user's side) for crucial technical operational aspects, could generally create problems.
2. One "lesson learned" concerning formal aspects is that there must be a guarantee in an ST-ESCOs contract in the case the End-User is unable to pay (e.g. bankrupted). This problem could be overtaken with a "Bank Guarantee" initially provided by the End-User.

2.3 Specific barriers etc. for Austria

From nahwaerme's experience with TPF projects, the lack in relevant dissemination activities towards all parties involved can be denoted as the main barrier that complicates the implementation of such projects on a broad basis. In many cases, both the end-user and the financing institute lack sufficient know-how about the state-of-the-art in solar thermal technology and about the technical and economical maturity that large solar thermal plants show today. This fact is even more important as TPF projects are to be implemented in new markets by companies lacking references, or if a company already owning reference projects wants to enter new markets with a possibly different technical framework. The most important topic to be addressed by a company on a sound technological level remains to convince the financiers. Usually, the solar company is required to assume the full technical responsibility for the solar plant!

The technical and the economical barriers should be faced jointly: only a solar company able to guarantee a technologically mature and smoothly operating plant can offer the necessary energy output needed to assure an economically advantageous system and provide long-term operating and economical stability to the customer. But the possible decrease of the thermal load of the end user during the contract term is a threat for the ST ESCO.

In many countries, the local price for fossil fuels and thus for district heating is still very low – in some cases supported by special subsidies. Even very good solar thermal plants with low investment and low operating costs have difficulties for being competitive when compared with heavily beat-down fossil fuel prices.

Large solar thermal plants are usually supported financially by some kind of subsidy. The subsidies may stem from a regional, a national or an European source, and therefore the extent of the subsidy that becomes effective for a project may vary quite heavily. On the long term, however, solar companies can not always count on subsidies to aid in the project implementation. Actually, as the prices for fossil fuels rise and solar thermal technologies become more widespread, it is more realistic to count with a decrease in subsidies for solar thermal projects. This is clearly an obstacle towards the implementation of TPF projects on a broader basis.

Some juridical aspects have to be removed in order to enable the implementation of a TPF project. The ownership structure of the building bearing the collectors must be checked to allow for the solar plant remaining the property of the solar company. In many countries, the legal conditions are such to convert all objects firmly fixed to a building (e.g. the solar collectors fixed on the roof) to the owner of the property. This would make it impossible to install a TPF project with the solar plant remaining in the solar company's property.

2.4 Specific barriers etc. for Spain

Energy services like ESCOs offer a lot of benefits for customers. However, the full potential is still not tapped and a lot of persuasion is necessary to start new projects.

One important reason why energy services are not used to a greater extent is that customers, building owners and decision makers <u>are not well informed about energy service companies</u> and the concept of performance-based contracting.

There is still <u>a lack of confidence</u> in the operation of such models, where it is needed to sign a very long contract with a solar company or so.

Customers have to remove all uncertainties about well-operation, solar guaranteed results, and besides high quality offers target-oriented marketing activities are required to make ESCOs be better known and to convince potential clients.

Goals of such ST-ESCOs Marketing activities are: i) To improve the knowledge of potential clients and decision makers about ESCOs; ii) To help start new projects with target-oriented information and persuasion.

The identified barriers are shown hereafter, classified per category:

<u>Financial, Contractual and Legal Aspects</u>

- The contractual conditions have to be much more clear for the potential actors, Some documents to start conversations and to negotiate some ST-ESCOs projects are totally needed.
- The Invoicing system must be clear for the ST-ESCOs and the End-Users from the beginning, and that has to be clear in the Contract. Some uncertainties in how to invoice and when, reference prices as fuel or natural gas.

Warranties for the accounting of energy are totally needed, by using energy differential account systems or by volume. To be included in the Contract.

- Many difficulties to contract the insurance for this kind of facilities. The insurance companies see some risks in do that.
- There is no experience for Public Administration contracting in preparing the technical and administrative requirements needed to request some offers. For instance, for Public hospital, public sports centers, etc. Although, it is ongoing in Spain a special programme in the Industry Department to regulate the Contract for the supply and maintenance of ESCOS for the Public administrations. This contract model intends to perform 5 performances features:
- Energy management, which objective is to manage the different supplies of fuels and electricity, including quality, quantity and usage,
- Prevent maintenance for the installations,
- Total warranty,
- The Servicer is committed to carry out all the improvements and renewing the installations,
- And the last one is to "improve the energy management".

Nevertheless, the Maastricht criteria do not permit a new public indebtedness of more than three percent of the gross domestic product (BIP), as well as a total indebtedness of the public budget more than 60 percent of the BIP. According to type and the classification of the municipal task, investments influence the public indebtedness and the public deficit. To raise a loan to invest in projects increase the indebtedness of the public hand, whereas leasing agreements are not shown up in the indebtedness. Therefore, the municipalities try to avoid financing structures by loan. Thus, new organisation and financing structures have to be considered.
- Financial entities do not really have a real interest in the ST-ESCOs formula, as the loan associate to invest are not so important as for solar photovoltaic facilities.
- Many difficulties for ST-ESCOs in community housing, where this has to be dealt as community service, and where solar system is seen as something that can fault.
- There are a similar European project some years ago named, "Solar Results Purchasing", where a part of these issues were developed. To be used as reference.
- The contacted insurance companies do not really see any advantage in this type of projects, just when it is clearly explained and at very detailed level. The halting insurance, which is totally needed, is a clear barrier to formalise the insurance policy.

<u>Marketing Aspects</u>

- The negotiations between ST-ESCOs and End-Users, while a third party is trying to promote an ST-ESCOs project, is solved by using the following criteria: "the economic benefits provides for the installation will be share 50%-50% for the first 20 years of operation".
- At the beginning, some pilot plants to impulse and to promote ST-ESCOs must be public, otherwise is going to be very difficult penetrating this formula.
- The investment done by ST-ESCOs do not avoid the invest in the convention thermal system, as well. This can be meaning a great economic inefficiency.

- People and managers of private and public companies really believe that prices for the conventional fuels are not going to increase dramatically.

2.5 Specific barriers etc. for Italy

Solar thermal technologies are still not commonly employed in Italian ESCO's installations. The current legislative and financial framework in what concerns ESCOs is described in Annex VI.

The main barriers for the diffusion of the solar thermal systems through ESCO's are several:

- There is a lack of experience and know-how on the technology, in particular large scale plants, their economic and environmental benefits. Quite few are in fact the large scale installations as whole in Italy.

- Financial institutions even if they start to have departments dedicated to energy and renewable projects, are not yet able (and ready) to assess the energy performance of a medium/large scale solar thermal plant. As consequence, a part few cases of small local banks, it is hard to achieve loans at a competitive interest rate for solar thermal installations.

- End users, driven by lack of awareness (or misinformation), can easily find the disadvantages of a solar thermal plant (e.g., risks connected with a more complex heating plant), and do not have a correct perception about the real entity of energy production and economic savings.

- There is lack of technical knowledge and expertise between the possible ST-ESCOs developers. In fact, the potential and the performances of large solar thermal installations are still not well known to the possible investors and to the technical actors. Therefore the perception of risk is usually too high.

- Financial incentives are limited and discontinuous: no long-term financial incentive for solar thermal technologies are present, and there is a lack of national coordination. At the moment the only incentives are from some local authorities, no national plan is at the moment available. Moreover discontinuous subsidies did not help to develop a strong industry and did not attract investments in the sector.

Energy service in the public sector in Italy is an established sector of business since the end of the eighties, due to the introduction of a peculiar legislation. Nevertheless, two are the main problems to the ST-ESCO concepts diffusion at the moment:

- Length of contracts: the majority of the energy service contracts used by public authorities do not exceed five years. Therefore it is difficult to introduce in these contracts the use of technologies or applications which require high investment costs (e.g., building refurbishment towards energy needs reduction, installation of solar thermal plants) which normally present longer pay back times.
- Economic performance: the companies dealing with energy services in the public sector are several in Italy, some of them are part of large multinational industrial groups (e.g., SIRAM, Cofathec, etc.). These companies do not normally implement installations using solar thermal technologies, if not explicitly required in the contract, since they do not turn to be economically competitive against standard technologies (e.g., co-generation). The latter is partially caused by the higher specific prices of solar thermal systems in Italy due to the small development of the market in comparison to other countries.

3 Opportunities and Threats (O&T)

3.1 Common Aspects

The opportunities are divided in two main categories: those for end-users and those for developers[2].

<u>Opportunities for end users:</u>

- No risk of initial investment
- Increased security of energy supply
- Low and more stable energy price - Reduced dependency on oil price variations
- Avoid of service and maintenance troubles
- New opportunities by using the specialised know - how of the energy service companies
- No lack of human resources since planning and investments are carried out by the ST-ESCO
- Better living quality and appreciation of buildings (energy labelling)
- Service package from one source
- Reduction of pollutant and CO_2 emissions
- Environmental friendly image
- Impulses for the local economy

<u>Opportunities for the ST-ESCOs developers:</u>

[2] Obviously the major part of the opportunities and threats are not country specific.

- The development of the ST-ESCOs market represents a new field for investments on the energy sector.
- ST-ESCOs market has a wide and promising potential.
- Long term contracts with high IRR are possible.
- Developers of ST-ESCOs business will achieve an Environmental Friendly Image with direct marketing and indirect economical benefits.

In what concerns threats, these regard mainly the possible ST-ESCOs developers and could be summarised as follows:

1. The usual threat of poor quality solar thermal systems.
2. The "on and off" of the subsidies that may destabilise the market.
3. The possibility to face a serious and persistent load reduction by the end user.

Follow some comments on how these three threats are (or could be) faced:

1. The first threat (poor quality of systems) is automatically reduced by the nature of ST-ESCO contracts. In fact, it is only the quality and high efficiency of the solar thermal systems that really ensures benefits for the ST-ESCO developer.
2. The second point (interrupted and unstable subsidies) is a serious problem. The solar thermal market destabilization due to this problem has been experienced in European countries like Italy and Germany; it can be faced only with appropriate policy measures.
3. The third threat (load reduction) is the most specific for ST-ESCOs. In fact, the thermal load should be as constant as possible in the long term since generally there is no possibility to divert the thermal energy produced to other end-users or to a network (as it is the case with electricity). Of course, the ST-ESCO contract can always face a load reduction by setting a "minimum compulsory consumption" that has to be paid even if the user has consumed less thermal energy in reality. However, the end-user may consider these contracts' terms as particularly risky and this may become a serious barrier for the diffusion of ST-ESCO agreements. In order to minimise the above risk, the following measures should be taken:
    a. Examine carefully the end-user's load in the long term.
    b. Seek for a minor participation of the End-User in the initial investment (e.g.15%, equal to the cost of the non *removable parts of the plant*).
    c. Ensure, as far as possible, the modularity of the solar thermal plant. This aspect is further examined in the paragraph on "appropriate technology for ST-ESCOs".

3.2 Specific O&T for Hellas

It has been found that the size of the yearly energy bills of Hellenic public administration buildings is considerable and there is a big potential for energy savings with proven energy technologies of relatively low overall pay-back times.

Apart from public buildings, there is high thermal energy consumption in Hellas in various sectors where solar plants are applicable as it is shown in the «Market Analysis» report of ST-ESCOs project.

In what concerns the barrier of the OPC subsidy (that, as described previously, can be given only to the end-user), a practical way[3] to overcome this problem currently in Hellas is to formulate a contract (signed by the ST-ESCO and the End-User) with the following terms (among others):

- The end-user is the owner of the plant from the beginning of the installation (without investing in it).
- The end user will receive the subsidy.
- The ST-ESCO will be paid by the End-User in rates that include:
    - the subsidy
    - an amount that depends on the gains of the solar plant (as would have been in typical ESCO contracts)

3.3 *Specific O&T for Austria*

Legislative, financial, contractual and marketing framework, opportunities and threats

In Austria there are definitely opportunities for ST-ESCO development because the economic potential (public and private buildings, industry… - see below) and the framework conditions are favourable for the implementation. The legal framework conditions for contracting projects are the same as for every other legal contract. Difficulties can occur by awarding energy service contracts for public buildings (public procurement regulations for awarding).

It is also crucial for a successful implementation of a solar thermal ESCO project to have a close connection to a small local financing institute with flat command structures. Possible treats which ST-ESCOs have to face in Austria are uncertain amount of subsidies and unstable development of the energy prices. Furthermore lack of sufficient knowledge about the state of the art in solar thermal technology (technical and economical maturity) of end users and financing institutes is a barrier for ST ESCOs. The possible decrease of the thermal of the end user load during the contract term is also a threat.

A more detailed description of the above mentioned opportunities and threats can be found in the following topics.

Economic potential

In Austria many public buildings (federal, county, municipal) are suited for energy services.

During the last years the financial scope of municipalities has become very little. The Maastricht criteria do not permit a new public indebtedness of more than three percent of the gross domestic product (BIP), as well as a total indebtedness of the public

[3] This information has been provided by Mr. Ilias Nomikos (Sol Energy Hellas SA) that has applied this scheme in practice.

budget more than 60 percent of the BIP. According to type and the classification of the municipal task, investments influence the public indebtedness and the public deficit. To raise a loan to invest in projects increase the indebtedness of the public hand, whereas leasing agreements are not shown up in the indebtedness. Therefore, the municipalities try to avoid financing structures by loan. Thus, new organisation and financing structures have to be considered. The transfer of municipal tasks to private service providers represent itself as an alternative financing model. The integration of private capital and private know-how provides that municipalities do not have to invest with public money anymore. An immediate realisation of projects and a greater attraction for efficient economics are forced. The organisational relief of the public administration acquires remarkable cost savings.

Furthermore there is a potential for solar thermal energy services contracts at the following buildings and facilities:

- Multifamily residences
- Tourism facilities (e.g. hotels)
- Hospitals and old peoples homes
- Sports centres
- Industry buildings (especially food, textile, chemical industry)
- Office buildings
- District heating networks

In most cases it is interesting to implement an ST-ESCO project in the course of a new building or a refurbishment. The owners of these buildings and facilities are interested because they can minimize the technical and financial risk (guarantees for the solar thermal energy yield, low or now initial investment necessary).

Legal framework

The secure, sustainable, and socially balanced supply of energy has been a focus of Austrian energy policy for the last two decades. The permanent promotion of renewable energy sources and the enhancement of a rational utilisation of energy are the basic strategic aspects of this policy. The positive development is to be attributed also to a traditionally high level of environmental consciousness of the Austrian population, having supported the concept of energy efficiency and an enhanced utilisation of renewable energy sources.

Awareness of a global climate change as a result of greenhouse gas emissions lead to a series of activities in respect of climate protection in the 90ies, culminating in the agreements concluded within the framework of the Kyoto-protocol. Austria has actively participated in the negotiations for the Kyoto-protocol, both on UN-level and within the European Union, and has undertaken to reduce emissions of the six "Kyoto-greenhouse gases" (CO2, CH4, N2O, H-CFC, CFC, SF6) by 13 % by the target period 2008 to 2012 as compared to the 1990 values.

In order to attain this ambitious goal, the National Council adopted an "Austrian Climate Strategy 2008/2012"(http://www.accc.gv.at/englisch/e-strategie.htm, combining the efforts on the part of the Federal Government and the Laender into a co-ordinated strategy. The Climate Strategy is the basis for different special programmes.

In Austria the legal framework conditions for contracting projects are the same as for every other legal contract. However, difficulties can occur by awarding energy service contracts. The law of public procurement regulates the award of contracts by contracting authorities on the basis of a ”model approach”. In case of a private purchaser, the project in question can be negotiated and awarded without the obligation to observe the provisions of the law of public procurement.

The measures taken in connection with a more efficient supply and utilisation of energy are various and diverse. This results in a variety of different implementation "models" and consequently leads to a range of different goods and services offered. This in turn determines the type and number of the parties involved, the required contracts and the types thereof, the financing terms, etc.

General Legal Framework For Awarding Contracts

In particular in Germany and Austria, a number of energy service projects have been implemented in the field of public administration. There are still some uncertainties.

The general legal framework for contract awarding by public clients can be assessed as „predominantly positive". On principle, the regulations for awarding contracts do not provide any obstructions for the use of energy services by public clients. There are certain „problem areas", however, such as classifying Third Party Financing projects within certain categories of orders. It is therefore recommended that attention is paid to the relevant legal framework during the organisation of the project.

Law of public procurement

The law of public procurement is the dominating law within the legal framework conditions for Energy Performance Contracting (EPC) and Third Party Financing (TPF). At least public authorities, who want to increase the energy efficiency of their buildings and who were the main target group for EPC and TPF until now, have to follow the rules of law.

However, among public authorities the phenomenon of legal uncertainty frequently occurs with regard to the award of performance contracts. The law of public procurement regulates the award of contracts by public authorities on the basis of a “model approach”. In the case of a private purchaser, the project in question can be negotiated and awarded without the obligation to observe the provisions of the law of public procurement.

The measures taken in connection with a more efficient supply and utilisation of energy are various and diverse. This results in a variety of different implementation "models" and consequently leads to a range of different goods and services offered. This in turn determines the type and number of the parties involved, the required contracts and the types thereof, the financing terms, etc.

3.4 Specific O&T for Spain

In 2004, the accumulated collector surface installed was of 660.000 square meters. Nevertheless, the National Plan for promotion the Solar Thermal Energy in Spain (PFER) fixed the objective of 4.810.000 square meters by 2010, being a great part of this quantity expecting an important increase of collective facilities.

Some Opportunities are related below:

The expectations and opportunities seem to be favourable because of the some quantity of initiatives in this technology from public administrations. For instance, from I.D.A.E.. there was released a model of solar order per municipality that has been adopted by the main spanish cities like Madrid, Barcelona, Sevilla, etc.

Apart from the above, some municipalities are adopting other kind of favourable actions like:

- Bonus on taxes referred to buildings, installations and civil works, etc;
- Bonus on taxes for real estates;
- Own dissemination and information campaigns about solar thermal energy advantages.

In order to motivate the implementation of Solar Thermal energy the National Government is preparing the “Código Técnico de la Edificación –CTE-”, i.e. National regulation for save energy in buildings by incorporating a percentage of solar thermal energy depending of the region, normally overage about a 60-70% of demanded energy. The CTE Regulation is the National Transposition of the Directive on Energy performance in buildings savings potential 22% (2002/91/CE).

With the implementation of this regulation is expected that the installation of solar thermal energy will be increased about 8 times, passing in Spain from 78.000 square meters to 640.000 square meters installed per year. This quantity is needed to fulfil the National Plan for solar thermal energy, which was fixed in 4.841.000 m2 by 2010.

It is clear that in those conditions, CTE need to be urgently approved (in fact this has been approved by 28th, March-2006)

With respect to the Subsidies and Grants provided by national public administration, through I.D.A.E. it is well established a financial support by ICO-I.D.A.E. that intends to combine the direct subsidies with some type of interest loans, being both ways totally compatible. As a general rule, the maximum financial is about 96% of the eligible costs for each project. Where I.D.A.E. is providing a subsidy of about 30% of this eligible costs and the rest is signed by a loan through ICO lines support.

Some threats are really explained very detailed in the Barriers chapter.

Although the more important Threat is that technicians do not have experience enough on large solar installations and tele-monitoring is not usual. Formation of specialists is totally required, also at engineering level, for the implementation of quality solar plants with high quality, otherwise it may come a negative perception of the end-users about the solar thermal energy and ST-ESCOs applications.

3.5 Specific O&T for Italy

Energy contracting sector is growing in Italy, both in the private and in the public sectors. Since the energy market liberalization, new ways of contracting and managing the energy issues have been developed. A model of TPF contract is also provided (see Annex VII, “TPF SCHEME”).

Opportunities for both sectors are related to:

- the legislation on the “white certificates” that offers a market mechanism which already helps the diffusion of technologies which produce savings in primary energy terms, such as solar thermal plants.

- For what energy costs concern, Italy remain one of countries where the energy prices are higher than the average of the other OCSE nations [reference IEA review 2003]. In this sense the introduction of St-ESCOs projects is favorable.

- Any public administration in Italy has a limit on the current yearly expenses fixed by law (it corresponds to maximum growth rate of 4%). There are no limits on the investment costs. Moreover the energy bill is one of the main parts of the total costs for a public administration, due to the average low efficiency of the energy production and distribution systems. In this sense, capital costs for a solar thermal installation would be part of a not limited part of the budget, and help to reduce the yearly operation costs going in the direction required by law.

New legislative experiences are developing at national and local level:

- the 10/192 law (19th of August 2005) implementation of the EU 2002/91/CE directive on energy saving in buildings. Apart from the definition of building energy labeling (in which solar plants are well considered), introduces the obligation of solar thermal collectors for domestic hot water production in public buildings;

- innovative local building regulations, already adopted from several municipalities (e.g. Carugate and Corbetta (near Milan) applications, but also the guidelines suggested by the Province of Milan) introduce strict energy efficiency criteria for buildings in order to achieve all the necessary permissions for new constructions. The use of solar thermal plants is often compulsory to cover the 30% of DHW consumption.;

Threats are present for the diffusion of ST-ESCOs applications in both sectors, even if the potential for development is fairly high:

- The costs of solar thermal systems are still higher than the average in Europe; this could harm the proper development of the solar thermal market and of ST-ESCOs.
- Subsidies structure has been up to know strongly discontinuous. The effect was a low capacity of medium and long term planning of the investors and industrial stakeholders involved in the sector. As a consequence, the conditions for ESCOs which want to implements solar thermal technologies are not so favorable. A coordination of policy measures is required.
- The know-how on large solar installations and tele-monitoring is not spread. The latter could cause the implementation of low quality solar plants that may create a negative perception of the end-users about the ST-ESCOs applications.

In particular for what concerns the public sector:

- The introduction of a proper contractual form for energy service in the public sector would be needed to overcome the difficulties related with including the solar thermal technologies in the actual legislation on energy service.

4 Technical framework (monitoring, billing, tools etc.)

4.1 Common aspects

4.1.1 Appropriate technology for ST-ESCOs

A minimum collector area of a few hundreds of square meters (e.g. 200 m²) is advised for TPF solar thermal projects.

The most suitable solar technologies should have the following characteristics:

a) Proven and robust technology

b) Economically affordable

c) As flexible as possible in installing, uninstalling and modifying.

d) Both hydraulics and control should be as simple as possible.

e) The telemonitoring and control system should offer the following:

  i) Appropriate information in order to minimise the need for on-site visits (e.g. regular confirmation of good operating conditions by an SMS).

  ii) Appropriate information and control possibilities in order to optimise the system operation (especially in the first period after commissioning and after any important modification).

In order to achieve the above properties, solar plants should have design principles similar to the successful European plants, especially those called large-scale solar heating plants (more than 100 m^2 of collectors' area). Some of the basic principles are following:

a) Use of flat plate collectors if the temperature needs do not exceed 100º C.

b) Use of absorber with selective surface (very little additional cost, quite high efficiency improvement).

c) Use of Large collector modules (e.g. modules of 12 m^2) that minimize the installation time thus permitting quick and low cost modifications.

d) Adopt the so called “low flow rate” in the collectors primary circuit (i.e. about 10-12 $l/(h*m^2)$ instead of the usual 50 l/(h*m2). This principle, if correctly applied, results in the following positive plant characteristics:

  i) Simple hydraulics and the smallest possible tube diameters

  ii) Stratification in the solar accumulator vessels.

The common characteristics of Large Scale Solar Heating Systems are better depicted in Figure 1; the similarity of two plants with a large size difference (but with the same design principles) is evident.

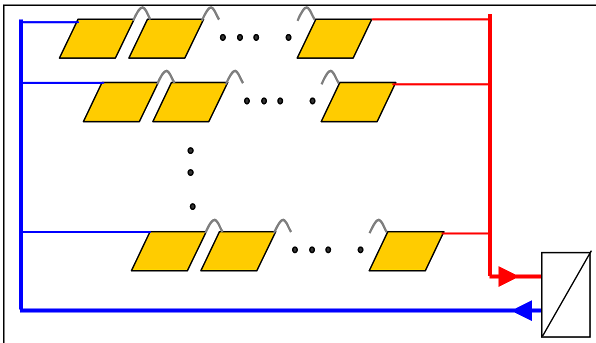	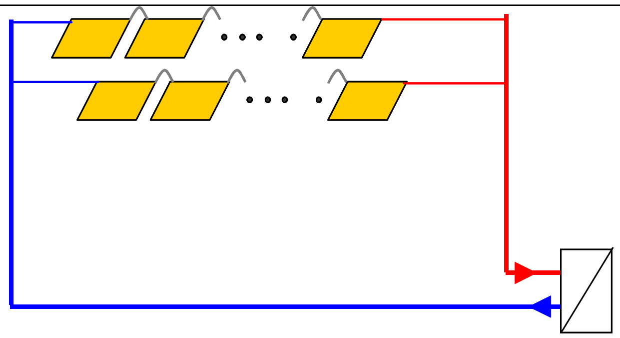
Marstal (DK-9040 m^2) Collectors modules=12,6 m^2 , modules/row=10, Flow=2-20 l/m^2,h	Melegnano (IT- 200 m^2) Collectors modules=12,5 m^2 , modules/row=8, Flow=6-20 l/m^2,h

Figure 1. Similarity of the characteristics for two “Large” but different size plants

As many solar system components as possible should be pre-assembled by the solar company; this includes first of all the pump and heat exchanger substations.

Some advantages of the pre-assembling are listed below:

- helps to reduce the error rate of components
- keeps the system simple on the plant site
- reduces the costs for operation and maintenance
- increases quality while decreasing the system price
- reduces the work-load on site

A focus should also be set on the control of modern solar thermal plants; a complete control system has several tasks. Among else,

- maximises the system’s energy output

- indicates possible malfunctions (e.g. leakages)
- helps to avoid failures by advanced warning on bad system values (e.g. too high pressure drop in a heat exchanger may indicate upcoming troubles…)
- is connected to nearby system components/sensors such as the temperature sensors of district heating, energy meter of the backup system, etc.

Usually, modern control systems have the possibility to be remotely controlled. A tele-monitoring and tele-control system is important to optimize the energy output and reduce maintenance costs.

Some sources with available material for design and maintenance guidelines are the following:

- Design and maintenance guidelines maxi-brochure (for solar thermal plants in industrial processes) of project PROCESOL II (ALTENER project - coordinator: CRES).(En)
- Solar –supported heating networks in multistory residential buildings, (A planning handbook), AEE INTEC, downloadable (En).
- Ambiente Italia: Design and maintenance guidelines; downloadable, in Italian

4.1.2 Quality, monitoring, billing

A list of the applicable standards (as of February 2006) is included in Annex III.

It is worth mentioning that an increasing number of manufacturers are involved in the implementation of the SOLAR KEYMARK. This quality mark has been developed by the European Solar Thermal Industry Federation (ESTIF) with the support of the European Commission and aims at harmonizing TEST & QUALITY certification procedures for solar thermal collectors and systems in Europe.

Regular service and maintenance of the solar system are indispensable features in order to guarantee the maximum energy output of the plant. The possibility for tele-monitoring and tele-controlling of a plant help to reduce the costs for service and maintenance to a great extent and to improve the energy output.

The international performance measurement and verification protocol (IPMVP) might be a good approach to standardize the internationally different ways to measure the energy output of a solar thermal (TPF) project. However, the complexity in the implementation of such a measurement protocol must not create expenses which make the system economically unattractive or much more difficult to implement. An internationally similar approach to the monitoring and verification of a solar thermal plant might also be an important topic when it comes to homogeneous European guidelines and subsidies for TPF solar thermal projects.

Along with the determination of the plant’s energy output, the basis price of the delivered energy per MWh or per kWh has to be fixed in the heat supply contract. Of course, the energy price is a very sensitive part of the heat supply contract. It can be fixed individually with the customer, but usually orients by the local prices either for district heating or for an available form of fossil fuel. One option is to link the price of the solar thermal kWh to the price of a fossil fuel, e.g. the cheapest available fossil fuel.

The energy price is usually linked to some price index, such as the consumer price index. Some kind of link with a conventional energy form might be a good feature to include. This allows to adjust the solar energy price to a mean energy price level which is expected to increase more rapidly than the consumer price index alone.

Also, the economical importance of a premature exit from the heat supply contract on the part of the customer should be addressed in the contract. This can be the case if the customer is not interested in the plant anymore or is not satisfied with the technical quality, or if the customer goes bankrupt. E.g., the costs for disassembly of the plant's technical equipment plus a fee for the loss of the earnings out of the plant might be charged. Another possibility is the arrangement of a bank guarantee to cover the financial risk linked with the described case.

4.1.3 Software tools available

For solar plants simulation the following programs are generally used: TRNSYS, TSOL, POLYSUN, f-chart, 3M.

In the ambit of ST-ESCOs project a software tool is to be developed for the quick assessment of possible ST-ESCOs applications. This will include a complete analysis (from technical considerations and energy optimisations to financial calculations). The aim is to create a simple and user-friendly interface for the user, although the software will elaborate complex aspects

4.2 Specific technical aspects for Hellas

4.2.1 Appropriate technology for ST-ESCOs

The use of large collector modules that are already present in middle and Northern Europe is not yet diffused in Hellas. However, after some investigation it has been found that some Hellenic Companies have sporadically produced large collectors (e.g. 10 m^2) for exportation purposes. This size is difficult to reproduce massively; however, the size of at least 6m^2 seems feasible for some important Hellenic Companies. As already said, the use of large collector modules minimizes the installation time, thus permitting quick and low cost modifications.

4.2.2 Quality, monitoring, billing

Although the standards of Annex III are not mandatory, manufacturers are voluntarily adhering and applying for certification of collectors, in order to be eligible for grants and loan guarantees. Another advantage for manufacturers is the possibility to be listed in a public database.

The formal monitoring procedure Hellas follows the standard "ISO/WD 9459/5. Solar heating - Domestic water heating systems - Part 5: System performance characterization by means of whole system testing and computer simulation."

In case there is formal need to certify if an existing monitoring equipment is working correctly, then a laboratory with the following certification should be involved:

"ISO/IEC/EN 17025 (formerly ISO Guide 25 & EN45001) "General Requirements for the Competence of Calibration and Testing Laboratories".

There is no standard procedure for billing the solar energy in Hellas. The available national experience (as it can be seen later in the existing applications description) offers two similar billing examples:

- In one application, the price of the solar kWh was equal to the cost of the kWh produced by the cheapest conventional fuel available (a continuously updated value).
- In another application, the price of the solar kWh was equal to the 80% of the conventional cost of the thermal kWh for the End User (this was also a continuously updated value).

The relation between solar kWh cost and End-User consumption is also an interesting point. Figure 2 offers an applied example.

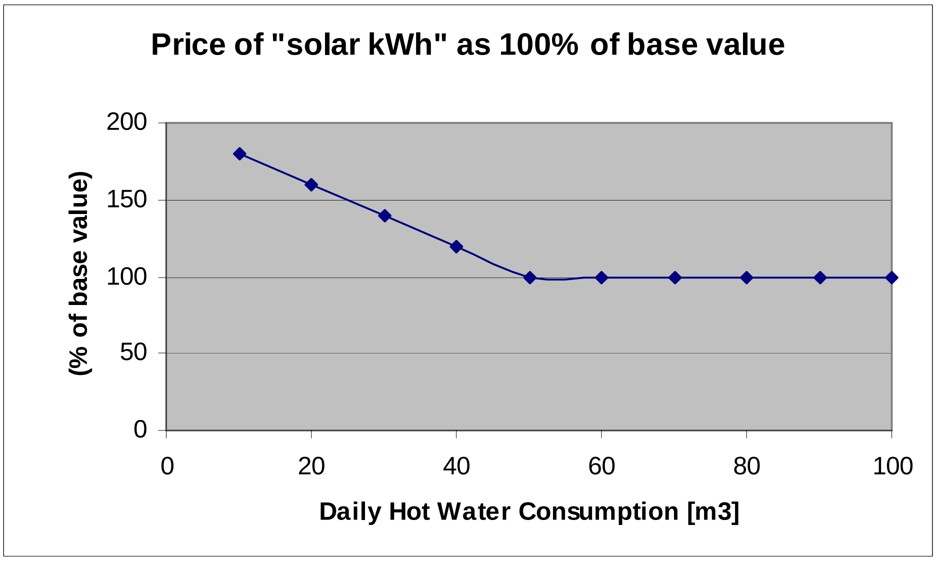

Figure 2. Solar kWh price in ACHAIA CLAUS as a function of End-User's consumption

4.2.3 Software tools available

From the Hellenic side, TRNSYS, TSOL, f-chart and 3M are available; T-SOL being considered as the most appropriate for the purposes of the current project. Additionally, TSOL offers also the possibility for a quite detailed economic analysis of the solar project.

1. In what concerns optimisation tools, the following are available:
    a. Hook and Jeeves (algorithm in FORTRAN for up to 12 parameters) used for the optimisation of the flow rate of the Large-scale solar heating plants. Can be adopted for other purposes with medium effort.
    b. A quite flexible and multitask optimisation tool developed by CRES, RES Direction.

4.3 Specific technical aspects for Austria

4.3.1 Appropriate technology for ST-ESCOs

General remarks

A minimum collector area of 200 to 300 m² is advised for TPF solar thermal projects. Thus, large scale solar collectors with high efficiency and long-term stability in efficiency should be used.

Large-area solar collectors…

- Allow quick mounting, dismounting and transport; they are thus more economical
- Reduce heat and pressure losses
- Must use absorbers with selective coating

The collector field should be designed for low flow rates, as this allows minimizing the dimensions of pipes and pumps and thus reduces system costs. Series connection of several large collectors helps to reduce or avoid problems of bad flow distribution. The correct dimensioning of all pump work is an essential topic.

If roof-integrated collectors are chosen, then attention has to be paid to the planning and the design of the buildings bearing the collectors. The orientation of the buildings should be orientated south-east to south-west, and if several subfields are installed on several buildings, the buildings should stand close together in order to minimize pipe length and to maximize energy output.

Other design conditions include:

- The flow in the collectors should not be too low; otherwise laminar flow might occur in the absorber leading to a drastically reduced heat transfer to the heat transport medium.
- Take care for high temperature durability of all parts possibly exposed to steam (during system stagnancy).
- Use high-quality metals and stable constructions for the collectors' substructure

4.3.2 Quality, monitoring, billing

In Austria no special monitoring certifications are officially required for the implementation of a TPF project. The only topic which has to be handled with some care is the choice of the heat meters utilized for the measurement of the plant's energy output. These heat meters do not only have to be positioned in the correct spot, they are also required to be officially calibrated according to an appropriate standard.

Benchmarking

Of course, it is always advantageous to employ components which bear some kind of quality certification, e.g. local environmental labels, or to choose products being manufactured according to some ISO certification, e.g. ISO 9001. The benchmarking of technologically similar solar thermal projects in terms of kWh per m² collector area might be a good approach to the comparison of different companies. A good benchmarking value for several plants requires a steady quality control and can thus be interpreted as a quality characteristic for the solar company

For billing purposes, no special software is used for nahwaerme's solar thermal TPF projects. Attention has to be paid upon the positions in the hydraulic pipe work where the heat meters are mounted. Afterwards, billing can be done with the help of the tele-monitoring system with the use of a simple excel sheet. Again, we see possibilities for improvement in this area, keeping in mind that possible software tools for billing via remote access must be reliable and robust.

Tele-monitoring system

A tool which has shown to be of good value in order to increase the energy output, decrease the cost for operation and maintenance and prevents possible malfunctions is a tele-monitoring and tele-control system.

A tele-monitoring system that provides remote monitoring and control of important solar plant parameters helps to insure that unwanted system conditions can be detected early and can be corrected prior to detrimental system malfunctions. This provides both system security and improved solar energy output. The tele-monitoring system assists in increasing system security, optimizing energy output and reducing costs for the operation, service and maintenance of the plants, since many adjustments can be done from the office without the need of sending technicians to the spot. In case of malfunction of the solar system, the control system can actively send out warning messages to ensure a quick readjustment.

The tele-monitoring system should include the potential for data storage. The objective is to provide a constant record of key system data such as temperature and energy curves which gives the opportunity to perform a deeper analysis of the system and thus enhance the optimization process. The data storage feature could include the possibility to download the stored data locally through an internet connection to the tele-monitoring system.

4.3.3 Software tools available

With the implementation of several successful third party financed and numerous large-scale directly-sold solar thermal projects in Austria nahwaerme has gathered valuable technical and economical know-how. Based on this know-how, so far it has not been necessary for nahwaerme to employ special simulation tools such as T-Sol or TRNSYS for large scale solar plants. However, without any doubt the use of a TRNSYS calculation for simulating the behavior of a large solar thermal plant under different customer and climatic conditions could be a valuable tool for improving the system dimensioning and the design of various system components.

Up to now, nahwaerme has not made use of TRNSYS for its everyday project implementation due to the increased engineering costs. Rather, nahwaerme has relied on its own Excel tools for calculating basic technical data such as pressure drops or economic cost effectiveness. These tools do definitely not present the best approach to the optimization of the plant technically along with a good method for increasing the economic efficiency. In this area, some improvement in the available software tools should be achieved, keeping in mind that all kind of software must pay off within one project, i.e. the economic and / or technical advantage stemming from the software must be higher than the possible increase in the engineering costs

4.4 Specific technical aspects for Spain

General comments

Some technical barriers were identified and must be solved in order to carry out the ST-ESCOs projects in Spain.

<u>Technical Aspects</u>

A. There are several doubts about the losses of yield in the boilers when water go into a high temperature as foreseen, for those installations where the ST installation is used for pre-heating the water entering into a conventional boiler.
B. The installers and technicians do not have information enough, and all installers are not really prepared to execute ST-ESCOs projects, because of the size of the facilities it is required an engineering effort and “know how”, which have not. It is require a major number of experts in this field.
C. Problems with over heating in the South Mediterranean area are important and have to be taken into account in design ST-ESCOs plants. Registered temperatures about 170 ºC in collectors have been measures.
D. Some doubts about the maturity of the technology is spread out between people and managers because of previous failure experiences. And reliability is right now a barrier for customers.

4.4.1 Appropiate technology for ST-ESCOs

There is actually none experience in Spain with large collector modules, although it could be a good opportunity for that to develop some ST-ESCOs projects with these technical specifications. The biggest size for each collector is about 5,9 square meters, being about 2 square meters the usual size.

4.4.2 Quality, monitoring and billing

All collectors that are used in Spain much fulfil the regulatory and the ISO rules. They are certified and homologated by a specific laboratory (INTA, CENER, etc) where are passing a lot of test of quality and durability. The ISO standards are the European standards.

4.4.3 Software tools available

TRANSOL 1.0. is the used software for the designing of solar thermal plants over 100 square meters. Other projects were designed with TRANSYS software, and also there are several excel.files (F-chart method, direct energy calculation) which are being used to calculate the size of the plants.

AIGUASOL, joint to the rest of partners, is developing a specific software for ST-ESCOs projects (maybe TRANSOL 2.0) were this will include a complete analysis (from technical considerations and energy optimisations to financial calculations).

The aim is to create a simple and user-friendly interface for the user, although the software will elaborate complex aspects

4.5 Specific technical aspects for Italy

4.5.1 Appropriate technology for ST-ESCOs

The majority of Italian solar thermal installations do not make use of large collector modules as in many other countries in Europe. Nevertheless, lately some systems have been built using imported large collector modules and some Italian producers started to work on modules of about six square meters forecasting to entry the market within 2006.

4.5.2 Quality, monitoring, billing

In the context of the certifications, in Italy the only compulsory rule is bound to the acknowledgement of the EU standards on the thermal solar plants (see Annexes III and V).

As regards the voluntary Italian certifications, Assolterm introduced since 2002, the Solar Pass certificate. To achieve the Solar Pass mark the companies must subscribe the "Solar Pass rule”, which represents an internal self-regulation code among the technology producers. The control function of the certification mechanism and its applications are carried out by the "Solar Pass scientific committee". Members of this committee are part of or nominated by Assolterm.

Two are the levels of certification:

- Solar Pass, that guarantees quality and performances of the system. It considers quality of the product, supplier's reliabilities, presence on the territory and technical assistance, adequacy and suitability of the price proportioned to the typology of the product, qualification and updating of the installation sector.
- Solar Pass install, meant to be a guarantee for the customer for what the choice of the installer is about (for what concerns: expertise possession, reliabilities, competence, quality of the installation and the technical assistance).

There is a wide discussion about the impact of the Solar Pass certification system and its structure. The main critics are about the absence of a third party independent auditor or controller, since the control function is played by the scientific committee which is formed by Assolterm. But the Assolterm associates are as well the ones who apply for the certificate. Moreover, there are not clear or strong enough consequences towards the actors which would not operate according to the rules of the certification.

There is no standard procedure for billing the solar energy in Italy.

4.5.3 Software tools available

In Italy Italian versions of both TSOL and POLYSUN are distributed. Shortly the Italian version of the Spanish software TRANSOL will be available. English versions of the afore mentioned software packages and TRNSYS are distributed.
For standard applications (e.g., domestic hot water in multi family house) all the packages, in their most comprehensive versions, offer the possibility to acquire the data for a quite detailed economic analysis of the solar project. For more peculiar applications only TRNSYS and the professional edition of POLYSUN can be employed.

5 Case studies

5.1 Hellenic case studies

5.1.1 MEVGAL S.A.

Mevgal S.A. is a dairy industry situated in Northern Hellas (between Thessaloniki and Giannitsa). Its main industrial activity is the production of dairy products (butter, cheese, butter milk, etc.). Steam is required by the various dairy processes of the plant (pasteurization, sterilization, evaporation and drying) and hot water is required for the operation of the Cleaning in Place (CIP) machine of the factory, which is used to clean and disinfect the utensils and machinery of the factory. Originally, steam was provided for by steam boilers running on heavy oil, which were fed cold water from the water supply grid. The water requirements of the steam boilers are about $75m^3$/day.

The plant (installed in 1999) consists of two solar thermal systems. The first system consists of 216 m^2 flat plate collectors with a black paint coating, located on the roof of the factory office building connected in series with 108 m^2 CPC collectors. The closed-loop primary circuit of the first system has two vertical, parallel, 5000 liters, closed solar storage tanks located in a specially designed room adjacent to the boiler room of the factory. The water-glycol mixture of the primary circuit heats the water in the solar storage tanks via flat-plate heat exchangers. The hot water produced by the solar system is used to pre-heat the water entering the steam boilers of the factory. The second system consists of 403 m^2 tube-fin, flat plate collectors with a selective paint coating, located on the roof of the cheese factory. The closed-loop primary circuit of the second system has two horizontal, in series, 2500 liters, closed solar storage tanks located on the roof of the cheese factory. Once again, flat-plate heat exchangers are used to heat the water in the solar storage tanks. The hot water produced is used to either feed the CIP machine or the solar storage tanks of the first system.

The solar plant is only a part of an installation which includes a heat recovery system from the steam boilers blow-down. Thermal energy savings are split as follows: 30% from solar and 70% from the blow-down heat recovery system.

The project was financed (with a TPF scheme) in the frame of a national programme (Operational Programme of Energy 1994 – 1999) and CRES was the contractor of the project. The bodies of project implementation were CRES and MEVGAL S.A.

Subcontractor for the installation of the whole system was the company Intersolar S.A.

The operation and maintenance of the system has been arranged by a private agreement between CRES and MEVGAL S.A. Based on this agreement, CRES has the responsibility of system's monitoring, operation, service and energy measurements. Once the payback period has been completed, the system will become exclusive property of the End-User. The contract agreement sets the kWh_{th} price to be equal to the cost of the kWh_{th} produced by the cheapest conventional fuel available (a continuously updated value). The total TPF investment for the whole application (solar plant and heat recovery measure), was about 130000 €. The mean annual energy savings are about 900 MWh and the price for each MWh equal to 25 € (in year 2005).

Table 1 presents main data of Mevgal project.

Data	Description
Dairy	MEVGAL is one of the largest dairy industries in Hellas
Year 1999	Staring operation year
75 m^3/day	Mean consumption of hot water
727 m^2	Collectors area installed
30%	Is the percentage of savings that come from solar (the rest 70% is from the blow-down equipment)
Price of kWh	It has been defined equal to the cost of the kWh produced by the cheapest conventional fuel available (a continuously updated value)
4 months	Is the billing period

Table 1. Main data for MEVGAL application

This successive example from Hellas is presented together with other applications in the participating countries separately (in an A4 format each) in the "Case Studies" that are downloadable from the web site of the project http://www.cres.gr/st-escos/ under "Best Practices".

5.1.2 ACHAIA CLAUS

Achaia Clauss S.A. is a winery situated on the outskirts of the city of Patras. Its main industrial activity is the production of red, white and rose wine. Hot water (60–75 ^{0}C) is required for the washing and sterilization of the bottles in the bottling factory. The hot water consumption of the bottling process is 50 m^3/day. Originally, the hot water was provided for by a steam boiler running on diesel fuel, which heated the water in two parallel, horizontal, 3000 liters storage tanks (via a submerged heat exchanger) located in the boiler room of the plant according to the needs of the bottling process.

A solar system was installed in 1993 and consisted of the following items; 308 m^2 sandwich-type, flat plate collectors coated with black paint located on the roof of the winery; closed-loop primary circuit with an open expansion vessel and two (2) parallel, horizontal, 3,000 liters, closed solar storage tanks located on the roof of the winery. The water heated by the solar collectors was circulating in a closed loop and was heating the water in the solar storage tanks via submerged heat exchangers. Anti-freeze protection was provided on very cold winter days by activating the pump and circulating the water when the temperature dropped below a certain limit. The hot water leaving the solar storage tanks was fed to the two, original storage tanks where the auxiliary heating of the water was provided for by the steam boiler. A re-circulation branch had been included which consisted of a hydraulic branch connecting the solar storage tanks with the original storage tanks. When the water in the solar storage tanks was exceeding the temperature of the water in the original storage tanks a pump was activated, which circulated the hot water from the solar to the original storage tanks.

The system operated for 6 years yielding a mean performance of 300 kWh/year/m^2. One of the reasons for such a low solar yield was the poor insulation of the tanks.

Due to administrative and financial difficulties of the company, the necessary maintenance work on the system was not carried out and this inevitably led to corrosion problems and inefficient operation of the system. In 1999, the system has been shut down due to the severe corrosion problems encountered (25% of the collectors have either cracked glass covers, deformation of the plastic collector frame or rusting of the absorber plates).

The installation was financed with a TPF contract, whereby the user paid no money for the installation of the system, but paid the manufacturer the amount of energy supplied by the system on a monthly rate, based on a fixed rate per kWh decided upon before the installation of the system. A third, independent party, in this case the Centre for Renewable Energy Sources (CRES) undertook the monitoring of the system, which determined the energy supplied by the system.

Table 2 presents main data of Achaia Clauss project.

Data	Description
Wine	Achaia Clauss is an important wine industries in Hellas, Patras
SOLE S.A	The construction company had also the role of ST-ESCO.
Year 1993	Staring operation year
1999	End of operation
50 m^3/day	Mean consumption of hot water
308 m^2	Collectors area installed
Solar-only	No other renewable or energy saving technology has been applied
Price of kWh	It has been defined equal to the 80% of the conventional cost of the thermal kWh for the company (a continuously updated value)
oil	The conventional fuel used

Table 2. Main data for ACHAIA CLAUS application

5.2 Austrian case studies

Arnold-Schwarzenegger-Stadium Graz

The solar plant at the "Arnold Schwarzenegger Stadium" Graz (Austria) was put into operation in June 2002 and can be considered as the pilot project of feeding solar thermal energy directly into a district heating system. From the technical point of view, the main reason for the construction of the solar system was to develop and optimise the engineering for feeding solar energy into an urban district heating net. As a result, this solar plant is Europe's Premiere for solar district heating.

Technical aspects

The solar collectors were mounted on a steel substructure on the roof of the skating hall of the Arnold Schwarzenegger Stadium in Graz. The collector area of 1,407 m² is arranged in 11 rows, each bearing 9 collectors in series. The employed collectors are 14.3 m² large area flat plate collectors of the type "Gluatmugl". These collectors are especially designed for high temperature use, which means that they have increased insulation in order to lower heat losses below approx. 3.0 W/m²*K. The gained solar energy output reaches about 560-600 MWh per year (Graz has a yearly solar radiation of 1130 kWh/m²).

The district heating net in Graz has a minimum consumption of 10 MW also in summertime, and this solar plant reaches a maximum output of about 800 kW. The solar energy is directly transmitted to the heating net by an external heat exchanger. Large storage tanks are not necessary due to the constant energy consumption. Concerning CO2-emissions, this plant saves about 250 tons CO2 a year when compared with an oil fired boiler with a total efficiency of 70 %.

Economical aspects and partners

The plant is operated and financed via a third-party financing model. This pilot project is moreover supported by the city of Graz, the Steirische Wirtschaftsförderung and the Kommunalkredit Austria.

The project was developed in collaboration of the following 3 partners:

- S.O.L.I.D. Gesellschaft für Solarinstallation & Design mbH
- nahwaerme.at Energiecontracting GmbH & CoKG
- ÖkoTech Produktionsgesellschaft für Umwelttechnik mbH

S.O.L.I.D. was responsible for the design and the construction of the plant. The company nahwaerme.at took over the financing and operation of the plant by a third-party financing concept. The collectors were produced and mounted by the company ÖkoTech (Graz), they received the Austrian Environmental Award.

As this project is based on a third-party financing model, the operating company nahwaerme.at took over the total costs of construction including the integration in the district heating net. The operating costs of the solar plant (e.g. maintenance, power etc.) are also taken over by the operating company.

Between the company nahwaerme.at and the stadium administration a user agreement for the roof was signed. Also, between nahwaerme.at and the Grazer Stadtwerke (district heating section) a heat delivery contract concerning the feeding of solar heat into the district heating net was signed. The duration of the contract is 15 years with an option of prolongation.

Project development

The first concept of this project was made by the general managers of S.O.L.I.D. Gesellschaft für Solarinstallation & Design mbH, nahwaerme.at Energiecontracting GmbH & Co KG and ÖkoTech Produktionsgesellschaft für Umwelttechnik mbH at the beginning of 2001. Then first contacts to the energy and environmental referee, the stadium administration and the district heating section of the Grazer Stadtwerke (non-ST ESCO running the district heating system) were established, followed by contacts to financial support institutions. After promise of financial support by the state of Austria and the city of Graz the detailed planning began in autumn 2001. The project was promoted from the beginning by the energy and environmental referee of the city Graz. Due to the good co-operation with the partner companies and subcontractors, the construction of the plant was finished by mid of June 2002.

Solar plant “Berliner Ring”

The “Berliner Ring” is a residential area in Graz-Ragnitz (Austria). It consists of 25 multi-storey buildings which comprise 756 apartments. Before the installation of the solar system, hot water preparation and heating were entirely done by fuel oil. The total consumption amounted to about 1 million of light fuel oil per year. Yet, the reasons for the construction of the plants are not only economical (high consumption of fossil fuels with the old system), but also include economical and environmental aspects.

Technical aspects

On the roof of selected buildings of the “Berliner Ring” residential area, a solar thermal plant was constructed. A second part of the plant is currently yet under construction, and a third part is in the planning phase. The completed part of the system amounts to 479 m². When completed, the collector area of the solar system totals approx. 2600 m². The system is then expected to deliver approx. 1 GWh of solar thermal energy to the district heating net per year. The same amount of energy would free approx. 375 tons of CO_2 when supplied with an oil fired boiler with a total efficiency of 70 %. Primarily, the solar plant feeds the local district heating system; in the case of surplus energy available from the collectors, the solar output is fed into the large-area district heating system of the city of Graz.

Economical aspects and partners

The plant is operated and financed via a third-party financing model. The project was developed in collaboration of the following 3 partners:

- S.O.L.I.D. Gesellschaft für Solarinstallation & Design mbH
- nahwaerme.at Energiecontracting GmbH & CoKG
- ÖkoTech Produktionsgesellschaft für Umwelttechnik mbH

S.O.L.I.D. was responsible for the design and the construction of the plant. The company nahwaerme.at took over the financing and operation of the plant by a third-party financing concept. The collectors were produced and mounted by the company ÖkoTech (Graz), they received the Austrian Environmental Award. As this project is based on a Third-Party-Financing Model the total investment costs for the construction including the integration in the district heating net were borne by the operating company nahwaerme.at.

Project development

The energy supply in the district heating net is provided by the company Wärme-Direkt-Service (WDS) of the Energie Graz (the local non-ST ESCO). WDS takes the energy either from nahwaerme.at or from the large-area district heating system of Energie Graz.

Heat supply contracts are signed between nahwaerme.at, Energie Graz and WDS. In these contracts, the details regarding the feeding of the district heating nets are laid down. Moreover, a contract is signed with the homeowner community in order to manage the usage of the roof areas.

Installation of a solar plant - Friedrich Schiller dormitory, Austria

Name and Data of the building concerned: Friedrich Schiller dormitory, Elisabethstr. 85, 8010 Graz, 72 sanitary rooms

Period covered: 15 years

Main actors involved in the implementation of the project (Contractor, Client)

Contractor: WDS

Client: Friedrich Schiller dormitory

Technology involved / Investment costs: Installation of solar collector, and installations for the domestic hot water heating system.

Amount of financial resources involved / Investment costs: 93.430 Euro

Innovative aspects: the hot water is charged per m3 to a fixed price and there is a guarantee for the solar yield (kWh/m2*a).

Energy Savings: 2540 Euro per year

CO2-Reduction: 9 t/a

Additional Remarks: The overall evaluation is very good and it was only possible to realise the project with a TPF model. The key element of success was the enthusiasm of the student’s representative.

5.3 Spanish case studies

5.3.1. CLUB DE TENIS SABADELL

It is recently inaugurated the first solar thermal installation which is selling energy to the End-Users in Sabadell (17th January, 2006).

Pasch and Cia. company has finalised very recently the works for the installation of a solar thermal facility in the Sabadell Tennis Club, which energy production is in average about 20 m3 per day. The company makes known that this is the first time that in Spain is realised an activity of this kind in the solar thermal field.

The facility is composed by 58 solar thermal collectors, Sunmax marl, that are occupying up to 340 square meters. The technology and products are supplied by Solel company, that is represented by Pasch y Cia. in the Spanish market.

The production of 20 m3 per day of hot water to be used to heat an Olympic swimming pool of 25 meters, as well as covering an important part of the how water needs. Annually, it produces 277.000 kWh, which will be substituting the consumption of 31.500 Nm3 of natural gas per year. The facility will avoid to issue to the atmosphere about 70.000 kg of CO2 per year.

General Presentation

The Sabadell Tennis Club, near Barcelona, decided to reduce their energy bill by installing a solar thermal system. The system began to operate on January of the present year, covering part of the hot water demand and giving support to the swimming-pool.

Technical Aspects

Measures:
- Design and construction of the solar plant
- Financing via a state-owned corporate entity and direct subsidies
- Operation management

Results:
- Yearly hot water demand (DHW + swimming pool) : 720,5 MWh
- Collector area: 348 m²
- Expected yearly energy production: 868 kWh/m²

Contractual aspects

The ESCo (Pasch y Cia), contracted Aiguasol Enginyeria for the design of the solar plant, and the system was installed by Fototerm. The duration of the contract is 12 years, and at the end the plant becomes property of the end user, without any payment for this concept. The contract includes a minimum consume for the end user around the 85 % of the expected energy production. The billing is made monthly via a fixed quantity, and at the end of the year the result is compensated in agree with the real consume.

	
Figure 1. Solar collector modules (58 units of 5,8 square	Figure 2. Details of hydraulic system

meters)	and tele-control and monitoring

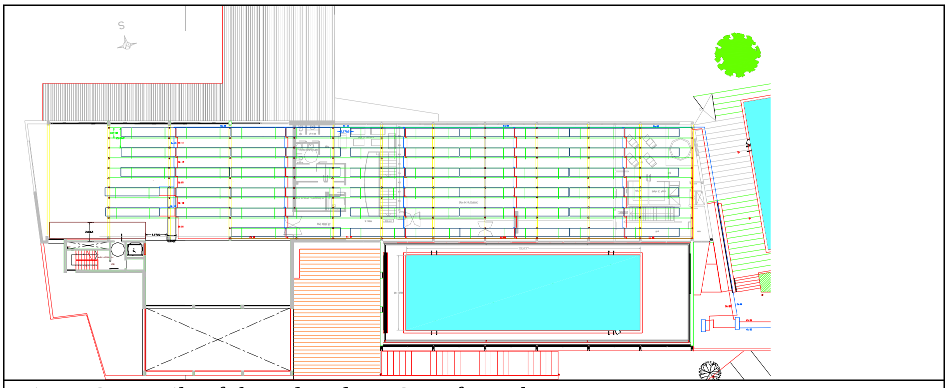

Figure 3. Details of the solar plant. Seen from the top

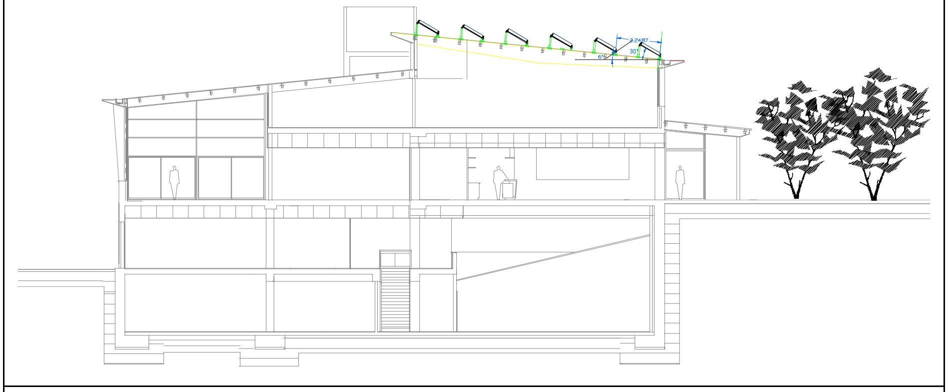

Figure 4. Details of the solar plant. Seen from the side

5.3.2. HOSPITAL DE REUS and HOSPITAL "MORALES MESEGUER" de Murcia.

In negotiation a new Contracts with the Reus Hospital, and "Morales Meseguer Hospital in Murcia (about 800 square meters and 115 m3 hot water per day).

5.4 Italian case studies

5.4.1 Rivadavia condominium, Sesto San Giovanni (Milan)

CEI (Calore Energia Impianti) a company involved on the energy services market, together with Fabbrica del sole (technical planners firm, specialized on renewable energies) installed a solar thermal plant to integrate the existing heating system for domestic hot water production (DHW) on a residential multi family house in Sesto San Giovanni, near Milan.

The condominium is composed by an unique building with 11 floors and consists of 132 apartments. The DHW consumption, is 22'500 liter/day (at 50 °C), with an annual consumption of 362 MWh.

The plant, realized at the end of 2005, has been designed in order to have a solar fraction of the 30%. It includes:

- 64 selective flat plate collectors, for a total surface of 163 m^2; they have been installed on the building roof, with an inclination of 25°;
- a new boiler of 5000 l has been installed, as integration of the existing one.

A regional subsidy has been taken for this realization, that covered the 30% of the total cost. The plant is guaranteed for 5 years with a GRS (guaranteed solar results) contract, and it's foreseen to pay back the total cost before the end of this contract.

The operation and maintenance of the plant are included in the energy service contract of the whole building, which was signed before the installation of the solar plant. The choice of installing the plant was taken from the ESCO and it is not an issue for the end-user. In other words the end-user does not see any difference in the service provided in terms of thermal comfort or energy bill. At the moment the price of solar thermal energy is the same of the conventional one. A possible revision of the economic part of the energy service contract is possible on contract renewal around 2010.

Figure 1: particular of the collectors

Figure 2: view of the building

6 References

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Annex I

Main elements of the ST-ESCO project and contract in MEVGAL dairy industry (Hellas).

The ST-ESCO project in MEVGAL dairy industry was developed in three phases

1st Phase

- Preparation and Signing of the Contract between ESCO and the Industry
- Call for tenders for the procurement of the equipment
- Final project study

2nd Phase

- Installation of the system
- Installation of the metering equipment
- Pilot operation of the system

3rd Phase

- Acceptance of the project
- Execution of measurements
- Corrections and fine tuning of the system
- Efficient operation of the system
- Final report

For this project 3 contracts were signed. These were:

- 1st Contract: Agreement between ESCO and Industry
- 2nd Contract: Agreement between ESCO and System Producer
- 3rd Contract: Contract for Energy Auditing and System Maintenance

1st Contract's main Articles

Disagreements and other Fiscal Issues

1. In cases of force majeure the obligations of the two sides will be postponed until the end of the events and within a period of 60 days
2. Both sides they have the right to denounce the contract with prior notification to the other side in cases such as:
    a. default of obligations without the possibility of their correction
    b. delayed payments, etc.

Contract Termination

1. With the normal termination of the contract the equipment comes to the proprietorship of the client

2. In the case of the contract denouncement the client has the obligation to buy the equipment at the real cost of the equipment subtracting the payments made from him

Transfer of Rights

1. Both sides have the right to transfer or sell their rights to a third party as long as the other party will be notified at a reasonable time and as long as that third party is competent and trustworthy

Assurance from the Client

1. The client guaranties that:
    a. he will operate his machinery as he was until the beginning of this contract,
    b. he will provide to the ESCO accurate and honest data and information,
    c. he will provide an annual check guaranty equal to the remaining cost of the system until its repayment.

2nd Contract's main Articles

Scope of the Contract

1. Commission, Construction, Installation and Efficient Operation of the Solar System.

Installation of the Equipment

1. The System Producer has the responsibility to construct and install the system as it is described in the final study and to achieve the predicted supply of solar energy and within the time frame agreed with this contract.
2. When the system will be built and installed it will be monitored in order to verify the expected energy supply.
3. In the case that the system provides less than 20% of the expected energy supply, the producer has the obligation to correct the installation at his own expenses.

3rd Contract's main Articles

Scope of the Contract

1. Technical Auditing and Maintenance of the System

Obligations Description

1. The client takes the responsibility of the auditing and preventively maintenance of the system and to notify in time the ESCO for any problems of the system where the client can not deal with.
2. The cost of the necessary actions for the preventively maintenance of the system that have to be taken, within the scope of this contract, from the side of the client will be cost and the ESCO will be notified in time in order to approve the cost.

Contract Duration

1. The duration of the contract starts with the signing of the contract and terminates with the full repayment of the system.

Annex II

Legislative and financial framework in Hellas

Note: main sources for this annex are [Task X–Hellas, 2003] and [Butson, 2001].

Related legal background in the public and the private sector for TPF and ESCOs.

Following the basic goals of national energy policy for a) the secure energy supply at a reasonable cost, b) the enhanced market competitiveness and progressive liberalization c) the environmental quality improvement and d) the independence from external energy factors, the government has been engaged to adopt activities that include :

- The drafting and issue of legal acts,
- The design and implementation of pilot and subsidy programme actions,
- The introduction of upgraded energy management infrastructure,
- The implementation of structural subsidy programmes for the rational exploitation of indigenous energy sources including Renewable Energy Sources (RES), for the broad promotion of Rational Use of Energy (RUE), for the penetration of natural gas to all end-energy uses and for the application of cogeneration of heat and power (CHP).

The Hellenic government has especially recognized the large and increasing magnitude of energy consumption and the high energy saving potential of especially the public building sector. From 1997 onwards, following the provisions of EU SAVE Directive 93/76/EEC, a specific focus has been given on the stimulation of TPF/EPC mechanism for energy efficiency investments in the public building sector (for energy efficiency, CHP and solar heat supply investments in hospitals and pools of public administration buildings). The general analysis of energy use in public administration buildings indicates that up to 30% energy savings can be achieved if an overall energy management strategy is adopted and appropriate energy conservation measures are implemented on the basis of well organized auditing, monitoring and targeting activities. The procedure for the implementation of energy saving or/and alternative and efficient energy supply measures in public administration facilities should refer to a considerable life cycle economic and environmental benefit as well as to the subsequent quality of offered services and to human comfort. Existing structural deficiencies of Hellenic public budgeting favour the option of EPC when deciding for public investments in energy efficiency. A distinction must be pointed out between the regime of state-owned and of rented public administration buildings. Possible proposals for EPC/TPF projects must be primarily oriented to proprietary public buildings administrations.

In relation to the national energy efficiency policy and specifically for Energy Performance Contracting, the legal framework includes:

- Two circulars of the ministry for public administration (1997) and the joint ministerial decision (JMD) 21475/4707 on the reduction of CO_2 emissions via improved building energy efficiency (1998), which have introduced the TPF/EPC option in the public building sector within a mandatory, well defined energy management procedure with complete energy auditing, monitoring and targeting actions.

- An infrastructure study assigned by the ministry of the environment regarding the organisation of energy management offices and the specification of the TPF mechanism procedures for energy saving investments for the public building administration, on the basis of JMD 21475/4707/98 mandates.
- An informative guidebook introducing EPC/TPF for public buildings which has been elaborated by the work team of MIPAD and CRES in order to be delivered among public administration energy management units.
- The implementation of OPC (Operational Program of Competitiveness) 2000-2006 Actions 2.1.1 (design, promotion and support activities) and 2.1.4 (public sector part) of the OPC 2000-2006, as detailed in the OPC Programming Supplement, which included up to 2005 the design and application of a special financial support scheme for the performance of energy investments (RUE/CHP/RES) in the public sector via the mechanism of TPF/EPC provided from private ESCOs.
- Elaboration and public presentation of the final draft and of complementary documentation on the new Law on *"TPF of Energy Investments for Energy Saving, Cogeneration & Independent Generation of Electrical or/and Thermal Energy from RES"* (2001). This Law, when issued, will establish formally the TPF mechanism and primarily the framework for ESCOs operation in Hellas for the performance of private sector investments (including investment subsidy opportunities from the EU 3^{d} Community Support Framework for Hellas-Operational Programme for Competitiveness (OPC) 2000-2006 / Actions 2.1.3, 2.1.4 for the private sector energy (RUE/RES/CHP) investments, or from other financial aid source). This Law will not tackle in particular the open topic of guaranteed energy saving contracting process in the public sector, but it will be relevant to public sector EPC as it will establish legally the ESCO business in Hellas.

Preliminary identification of appropriate financial institutions.

The most appropriate financing institutions are of course banks or other similar institutions such as insurance companies. In some cases utility companies could play this role. In some other cases the finance of the projects comes from the equipment suppliers (solar companies, heating plant companies, etc).

Up to now, since financing institutions are not yet actively involved on ESCO schemes and TPF projects, no specific financial schemes and requirements have been adopted.

In MEVGAL project, where CRES played the role of the ESCO, the finance came from a loan (Hellenic Bank of Industrial Development – ETBA). The guaranty of the loan was the contract itself.

In the case of ACHAIA CLAUSS, the project was financed from the Solar System provider.

Annex III

List of applicable standards for solar thermal systems and components

EN 12975-1: Thermal solar systems and components – Collectors

Part 1: General Requirements

EN 12975-2: Thermal solar systems and components – Collectors

Part 2: Test methods

EN 12976-1: Thermal solar systems and components – Factory made systems

Part 1: General requirements

EN 12976-2: Thermal solar systems and components – Factory made systems

Part 2: Test methods

EN 12977-1: Thermal solar systems and components – Custom built systems

Part 1: general Requirements

EN 12977-2: Thermal solar systems and components – Custom built systems

Part 2: Test methods

ISO 9806-1 (1994) – Test methods for solar collectors

Part 1: Thermal performance of glazed liquid heating collectors including pressure drop.

ISO 9806-2 (1995) – Test methods for solar collectors

Part 2: Qualification test procedures.

ISO 9806-3 (1995) – Test methods for solar collectors

Part 3: Thermal performance of unglazed liquid heating collectors (sensible heat transfer only) including pressure drop.

ISO/DIS 11924 – Solar heating -Domestic water heating systems

Part 4: Test methods for the assessment of protection from excessive temperatures, pressures and potable water contamination.

Other relevant standards:

ISO 9459/1 – Solar heating domestic water heating systems

Part 1: Performance rating procedure using indoor test methods.

ISO 9459/3 – Solar heating domestic water heating systems

Part 3: Procedures for system component characterisation and prediction for yearly performance using component performance data.

ISO/WD 9459/4 – Solar heating domestic water heating systems

Part 4: System performance characterisation by means of component testing and whole system simulation.

Annex IV

Programs of the federal government (AT)

<u>Program “klima:aktiv”</u>

The climate protection program "klima:aktiv" (more information: http://www.klimaschutz2004.at/article/archive/594), lead by the Federal Ministry for the Environment, has been commenced on the federal level in 2003.

The central instruments included in the climate strategy (subsidies, fiscal political measures etc.) are supported and completed by the klima:aktiv program. Klima:aktiv will change the technology and service market in a specific and sustainable way in the sense of the climate protection.

The klima:aktiv goals:

- To lower the energy consumption and support the CO2 neutral energy use
- Improvement of the start chances and increase of the market share of climate protecting products and services
- Strengthening of the business location Austria: future oriented and innovative
- Activation and networking of the important actors

The strategy

Klima:aktiv programs last over several years and are comprehensive collections of co-ordinated actions in one topic field with the goal to make climate protecting Concerning Contracting models three programs have already started the Contracting-Initiative for Austria's Federal Buildings, the program Ecofacility and the program solar:wärme.

The project “Contracting-Initiative for Austria's Federal Buildings” is headed by a co-operative association of the Federal Ministry for Economy and Labour (BMWA), the Federal Ministry for Land and Forest Management, Environmental and Water Management (BMLFUW) and Bundesimmobiliengesellschaft (BIG), the federal real estate agency. In the past, energy-saving investments in federally owned buildings often had to be postponed in favour of urgently necessary repair measures. The federal government was not able to provide the budgetary funds in the required amount at short notice. For numerous buildings, the operating maintenance has been eliminated for cost reasons this project has been started to avoid this.

After nearly two years project management, remarkable results can be seen. For about 100 buildings suitable ESCOs were already found. Average savings of 20% of the annual energy costs are guaranteed for these buildings within the contract period (ten years). More information: http://www.bundescontracting.at Ecofacility is an initiative of the Austrian Ministry for Agriculture and Forest Management, Environment and Water Management. The management of the program was taken over by the Austrian Energy Agency, which carries it out in co-operation with several partners (like e.g. Graz Energy Agency). The middle-term and the long-term objective of the klima:aktiv - program Ecofacility is to improve the quality of reconstruction in private service buildings and to lower the operating costs in these buildings effectively.

The main emphases of the proposal are:

- creation of a network of qualified contracting consultants
- information and marketing activities for target groups
- setting quality standards for enterprises of contractors
- improving organisation within public building administration in order to facilitate contracting projects
- linking the Impulse Program with the promotion of contracting in private sector service buildings through a regionally organised program on raising environmental awareness.

A lot of projects could be realised successfully within Ecofacility see: http://www.klimaaktiv.at/index-programme.

The program solar:wärme started 2004. The action program solar:wärme involves a several years lasting program in Austria with defined main points. The aim is to reach an average increase rate of 18 % of the yearly installed solar thermal collector area from the year 2004 till 2010. More information http://www.klimaaktiv.at/index-programme.

Annex V

Italian applicable standandards for solar thermal systems

UNI 8211:1981
Solar energy heating systems. Terminology, functions, requirements and performances for their integration in building
UNI 8212- :1986/1987
- 1 Flat plate solar collectors. Dry stagnation exposure test.
- 2 Flat plate solar collectors. External thermal shock test.
- 3 Flat plate solar collectors. Overpressure resistance test.
- 4 Flat plate solar collectors. Water tightness test.
- 5 Flat plate solar collectors. Internal thermal shock test.
- 6 Flat plate solar collectors. Hail resistance test.
- 7 Determination of the pressure losses.
- 8 Salt spray test
- 9 Determination of the thermal efficiency.

UNI 8477- :1983/1985
- 1 Solar energy. Calculation of energy gains for building applications. Evaluation of radiant received energy
-2 Solar energy. Calculation of energy gains for building applications. Evaluation of energy gains coming from active or passive systems

UNI 8796:1987
Solar systems. Liquid solar collectors. Acceptance criteria.
UNI 8872:1985
Flat plate solar collectors. Design and control criteria of the reliability and durability requirements.
UNI 8873- :1987
- 1 Solar systems. Hot water storage tanks. Acceptance criteria.
- 2 Solar systems. Hot water storage tanks. Test methods.

UNI 8937:1987
Air heating flat plate solar collectors. Determination of the thermal efficiency.
UNI 9711:1991
Building. Solar-assisted heating systems.
UNI EN ISO 15927-1:2004
Hygrothermal performance of buildings - Calculation and presentation of climatic data -Monthly means of single meteorological elements
UNI 8157:1984
Heat meters for heating plants based on thermal balance of heat conveying liquid.
UNI 9023:1987
Heat meters. Installation, use and maintenance.

Annex VI

Italian legislative, financial and marketing framework

Legal background for TPF and ESCOs

THE 10/91 LAW

It is a very important law in the energy matter; unfortunately most in the concept introduced than in their real application.

Among the aims of the law 10/91 there is:

- the development of renewable sources for energy production;
- the energy saving, through the improvement of the efficiency of the thermal plants and the rational use of the energy.

The first aim was clearly expressed, and so clearly unapplied. It's written that in the public properties or public use buildings there's the obligation to satisfy the energy needs by the recourse to renewable energy sources (or assimilate) except for technical or economic nature impediments. Till now, there are just few experiences of renewable utilization in public buildings, concentrated in few environment-sensible district.

For the energy savings, the law 10/91 introduced new instruments, in the energy management:

- the concept and definition of rational use of energy in buildings;
- the figure of the energy manager and of the third-person in charge;
- the definition of heat service contract.

The rational use of energy in buildings

The law introduces the concept of rational use of energy in buildings and fixes some minimum energy level of performance for buildings. These performance levels will be soon updated by the acknowledgement of the new European Directive on energy buildings performance.

Energy manager

The law 10/91 institutes the obligation to name a person in charge for the conservation and the rational use of the energy in the sectors with an important consumption of energy (10.000 annual toe for industrial sector, 1.000 toe for Public Administration and tertiary, in primary sources).

Third responsabile

He is the physical or juridical person delegated to the responsibility of the thermal plants, for the exercise, the maintenance and the reduction of energy consumptions. Detail of tasks has been drafted in the D.P.R. n.412/93.

Energy service[4]

[4] The discipline of the "Energy Service" contract is regulated by the following legislation:

- N.10/91 law;
- D.P.R. n.412/93, with the updating introduced by the D.P.R. 551/2000: rule about standards for the design, the installation, the exercise and the maintenance of the thermal plants of the buildings, at the purposes of the reduction of the energy consumptions; it takes the definition of the Energy Service contract.

And by the following resolutions of the Finance Ministry:

- n.103/E of 06.20.98 and n.113 of 08.26.98: applicability of VAT rate at 10%;

Well-known from the law 10/91, it's completely defined from the DPR 412/93. It is about the contractual action that disciplines the energy supply at certain comfort conditions in the buildings. To make easier the improvement of this model of contract, the legislator has foreseen the appliance of a reduced VAT of 10%.

THE ENERGY EFFICIENCY DECREES (DM 20/07/2004)

The E.E. Decrees require to each Electricity and Gas Distributor, with more than 100.000 end-users served (at the end of 2001), to achieve definite reduction of the amounts of primary energy consumption, through the implementation of energy saving measures. The amount of savings (in terms primary energy) is fixed as percentage of the energy distributed; once fixed the total amount of energy savings target, the goal for each distributor is a percentage of it equal to its percentage on the total distributed energy. The whole amount of savings is shown in Table 2. As shown, it increases every year until the 5th year ; after this time, no new goals will be bound by law. At least 50% of the savings must be obtained on the type of energy distributed (Gas for gas distributors and electricity for electricity distributors).

Primary energy savings in Mtoe/year				
Year	Cum. El.	Year El.	Cum. Gas	Year Gas
2005	0,1	-	0,1	-
2006	0,2	0,1	0,2	0,1
2007	0,4	0,2	0,4	0,2
2008	0,8	0,4	0,7	0,3
2009	1,6	0,8	1,3	0,6

Table 1 - amount of savings prescribed by law

The expected results in term of energy saving are shown in the graphics below, both for electric and natural gas market. The figures show the trend of TEE emission expected. The cumulative curves reach a peak in 2009, since it is not clear nowadays if the government will further oblige the distributors to implement energy saving measures. Therefore the curves show the most negative scenario. Obviously the decreasing part of the curve is related to the certificate issue, while the energy savings go on constantly for years..

- n.273 of 11.23.98; it lists the 10 minimum qualifications requested for the determination of "negotiate energy service";
- n.82/E of 04.07.99; "the domestic use" of the energy heat, at the VAT reduction purposes on the combustible, also in the jobs direct to satisfy the needs of environments what barracks, schools, kindergartens, houses of rest, etc. which lodge collectivities, with the objective of extends the shopkeepers corporations of such environments, in the context of such structures activities do not develop towards important considerations in the VAT purposes.

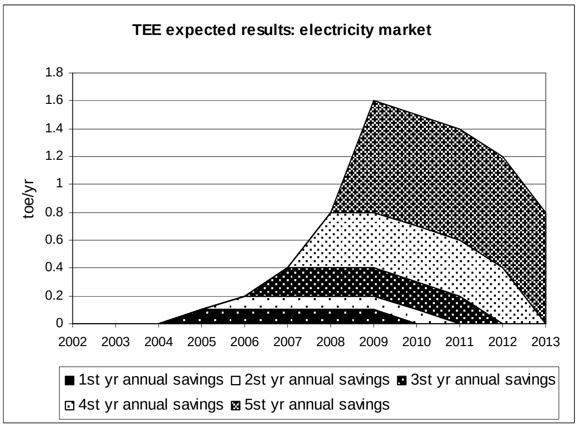

Figure 3 – Cumulative and yearly energy savings prescribed by law (decrees 20.07.2004) for Electricity distributors

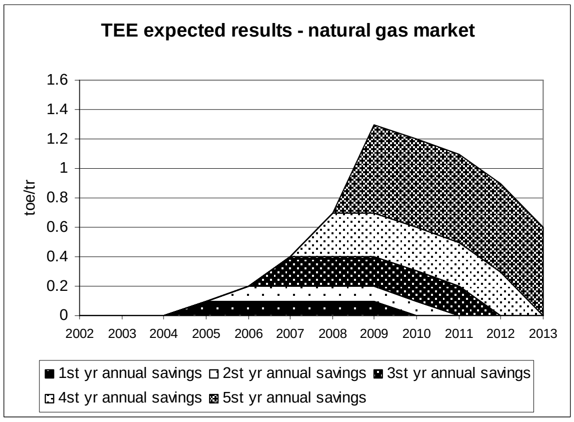

Figure 4 – Cumulative and yearly energy savings prescribed by law (decrees 20.07.2004) for Gas distributors

The only entities that can obtain EE certificates are energy distributors (bound subject) and ESCOs (voluntary actors). Interventations that can be taken in account for the calculation are the energy saving measures implemented from the 1st of January 2005.

So the distributors can reach the target in 3 different ways:

- directly, developing directly and by itself EE projects, or creating an agreement to develop EE projects with others subjects;
- indirectly, buying EE certificates from ESCOs;
- paying the sanction for the default of the obligation.

Schemes of the mechanism in shown in
Figure 5

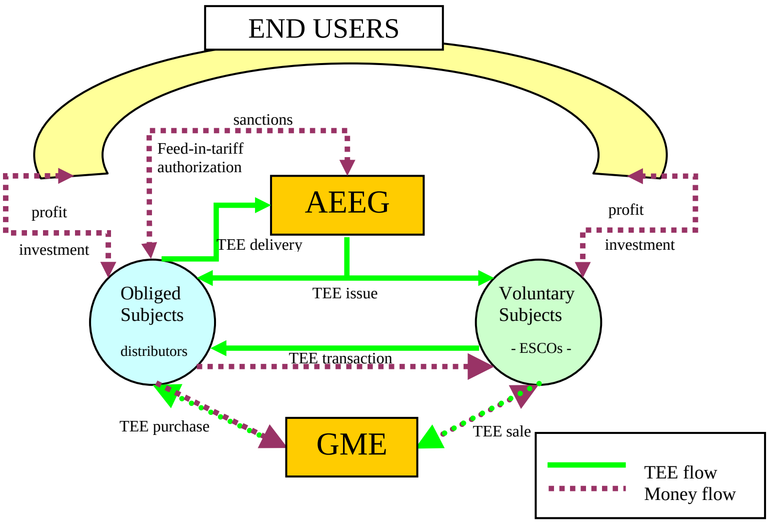

Figure 5 – Graphical representation of the trading system of the TEE

As well as the subjects of this mechanism (energy distributors and ESCOs), the Authority[5] also both the kind of action allowed and its value in term of primary energy reduction, and releases the corresponding certificates.
Energy efficiency projects can reach TEE though three ways:

- Standard projects are the ones that respect the AEEG technical forms, where are well defined all the characteristics of the project, the final use conditions and its value in term of saved primary energy.
- Analytical projects, for which an ad hoc energy efficiency indicator will be defined; the project and its indicator is proposed to the Authority that must evaluate and validate it;
- Consumptive projects; for realized projects is possible obtaining certificates showing proved results (if validated by the Authority).

The minimum project size to gain certificates is strictly related to the kind of interventations (typology of the project) and the subject (obliged or voluntary). Values are shown Table 2

typology of the project	obliged subjects	voluntary subjects
standardized	25 toe/yr	25 toe/yr
analytical	100 toe/yr	50 toe/yr
consumptive	200 toe/yr	100 toe/yr

Table 2 – Energy saving thresholds for the request of certificates

The savings obtained are taken in account for 5 years (8 years for electricity savings obtained from air conditioning).
The achievement of the target allow the distributor a feed-in-tariff mechanism to cover the investment, until a maximum value of 100€/toe saved. This is also the reference value of the certificate, before the starting of the open market. Then the price will depend from several factors, even if the limit for the feed-in-tariff will remain constant.

The main original characteristic of the decrees is the integration of control and regulation instruments (ruled by a centralized public institution – i.e., AEEG), with market ones.
The last purpose of these decrees is to open new spaces for energy efficiency technologies, both at market level and in reliability and knowledge increasing. The duration of the obligation, and the contributions to support it, is of 5 years, esteemed sufficient time to begin a virtuous circle of good practices. Main actors in this scenario are the ESCOs, to which the decrees give a specific and primary role.

However the application on a single ST-ESCO project can be difficult. In fact the energy savings acknowledgement is not so high; substituting gas, a plain collector can reach a certified energy saving from 61 to 123 10^{-3} toe/m^2. Considering the present economic condition (price: 100 €/toe saved, validity: 5 years) they don't seem to give a significant plus value for the project. Bur the main barrier still present is the size of the plant to reach certificates; considering an average value of 93.8 10^{-3} toe/m^2, the

[5] AEEG, Authority for Electric Energy and Gas

installation of 100 m^2 of collectors foresee avoided emissions for about 10 toe, that is lower to the minimum size accepted (ref. Table 2).
A very interesting experience has been developed by AzzeroCO2, an ESCo (it’s a formal ESCO, following the AEEG criteria, but it doesn’t operate like a real ESCO) that decided to collect all the certificates related to solar thermal installation that alone can’t reach certificates. So it creates a market otherwise impossible, both for the size of the projects and for the management cost of the procedure. The money obtained from this action is then distributed to AzzeroCO2, the producer and the end user (in terms of cost reduction).

Preliminary identification of appropriate financial institutions.

For the funding of ST.ESCOs projects, a first summary distinction is necessary, between big enterprises or consortiums and SME.
The first usually have a financial covering, that allows them a the certainty on the best finding of funds, still less more elasticity in the management of the contracts (having standard economic management procedures with proved reliability).
In the second case funding are searched on the market; the funding opportunities for ESCOs are rather diversified and dedicated products are growing.

The main ways for the funding source are fundamentally two:
- the recourse to 'merchant bank’;
- the funding for energy projects based on renewable sources.

The first is the more classical funding ambit, in which the funding (in capital account) is supplied by the credit institute behind guarantees normally considered. To facilitate the activity of ESCO, particular conditions exist any way.
At first, the typology of projects can characterize to be project-financing object.
Furthermore dedicated funds exist. An example is skillful from Banca Verde (now MPS group – Monte dei Paschi di Siena), which grant funding facilitated for initiatives involved in the environment (and territorial generally) improvement and increase in value. In this kind of bargaining, a good energy-saving project can be considered as guarantee for its same funding.
Category agreements are spreading in quite capillary way. An example is the one stipulated between CAN of Florence (Confederazione Nazionale Artigiani, piccole e medie imprese - national federation of the handicrafts and the little and middle enterprise) and 5 bank institutes, for the supply of services to favorable conditions, including funding at facilitated rate.
Bound in the context of projects related to the exploitation of renewable energies funding, new forms of agreement are born to support the development of these projects. Exemplary the case of "Sportello Verde"; it’s an initiative promoted by Legambiente (important Italian environmental association) together with the BCC (Cooperative Credit Banks) of the zone of Grosseto; it provides technical advice and access to facilitated credit for projects based on renewables. Guarantee for the loan is the plant itself, once verified the consistency of the project. The applied variable rate is equal to the Euribor 6 months put on 0.75 points; the duration is up to 10 year (maximum). The proposal wants to be pilot, for a future expansion of the programme to Federcasse, which assembles all the local BCC in Italy.

A special chapter deserves Banca Etica (Ethical Bank). It supports enterprises that show a strong attention to the social and environmental impact of their activity, through funding for compatible eco activities, supports for building bio enterprises, operations to finance the research and the production of energies from renewable sources. Besides the funding, Ethical Bank is engaged on the pouring of the creation and the widening of several environmental projects through the creation of a suitable office. Between the principal projects, relevant is the “Banca del Sole” (bank of the sun), which aims at the realization of an accessible net system between producers and consumers of alternative energies, to develop a market together otherwise hard. Ethical bank is realizing the study of feasibility of the project on behalf of the Ministry Of The Environment. The project "Banca del Sole " concerns the creation of an organism turned to the capillary diffusion of the renewable energy sources on the Italian territory. The association for the “Banca del Sole” has been constituted in the February 2002 and the task to coordinate such net has involved Banca Etica. “Banca del Sole” will represent the unitary subject able provide answers both technical and financial. “Banca del Sole” will not directly be responsible for the energy intermediation, but it will instead have as its aims:

- develop the 'net of the sun';
- realize intermediation of representative energy titles;
- development of guarantee tools.

Annex VII

Italy: Main elements of the ST-ESCO contract - general.

TPF SCHEME

In Italy funding through third part have done since eighty years, but till now it covers just a little part of funding search market. The causes can be the complexity of draft and management, or the little relevance given by the stakeholder (PA, bank and financial institutes, manufacturers etc.), but the core of the matter is that a great potential is still unexpressed.

A general contract scheme for TPF has been drawn up by ENEA[6]. Its structure has been thought for contracts between private industries and energy service company, but it can be well applied, in the public case, as reference for the draft of a contract. The elements characterizing the contract scheme have been identified in:

1. Definitions;
2. Privacy;
3. Feasibility study;
4. Putting into effect of the proposals;
5. Installation of plants;
6. Maintenance;
7. Insurance covering;
8. Payment;
9. Arrears;
10. Change of the presuppositions;
11. Uncontrollable events;
12. Resolution of the convention;
13. Consequences of the resolution;
14. Law dispositions;
15. Limits of the responsibility;
16. Composition of the controversies;
17. Alienation of interest in convention relation
18. Customer's guarantees;
19. VAT;
20. Preliminary study;
21. Communications;
22. Law applicable;

Principal content are reported. The supplier will execute a feasibility study, in order to verify if realizing a saving (with the current annual energy costs) is possible and, if the case, will formulate recommendations on the way to be followed to realize it. Once possibility of energy saving is verified the parts put in effect the proposal and the plant can be installed. The entire or the major part of plant costs are in charge at the supplier, who maintain the property of installations until the end of the convention. The customer will have in charge of the management, maintenance and repair of the installations. Assurance against the risks normally covered by a total insurance policy is furnished by the supplier, for the replacement value of the plant. For the supply of the services, the customer will pour the supplier a monthly canon, to a share of the value of the saved energy. The exact method for the calculation of such canon will be specified in the proposals. Interest on arrears are foreseen if costumer not paid in the established time. Changes about the reference consumptions contained in the proposal can be carried out if one o more presuppositions reveal themselves incorrect. Obligation will be suspended in case of uncontrollable events for 60 days maximum; after this period the contract can be resolute. The customer or supplier will

[6] Source site: http://spa.casaccia.enea.it/ftt.pdf

be able to interrupt the convention immediately (giving communication to the counterpart) if this omits of complying with one obligations in strength of the convention within *a period of reasonable time*. In the case in which convention is declared loose by the customer, the property of the plants installed by the supplier will pass to the customer. If the present convention is declared loose by the supplier, the customer will buy the installed plants. Supplier won't be responsible for any profit loss form the costumer in consequence of a breakdown of the plants, particularly if possible losses are caused by plants doing part of the installations which have not been installed by the supplier.

At present in Italy TPF contracts are mainly used by Public Administrations or ASL[7]. The foreseen competition procedure for the search of a TPF offer by a public administration, is related to the normative of the supply of services, and one therefore conforms to as established by the D.Lgs. 157/95. It foresees four possible alternative procedures:

- Public enchantment chase: procedure in which every enterprise can present an offer;
- Private tender: narrow procedure only the enterprises invited by the contracting administration take part in;
- contract-contest: narrow procedure in such as the candidate draws up the project of the service and shows the conditions and the prices to which it is disposed to execute the contract;
- private negotiation: negotiated procedure in which the administration consults the enterprises of its choice and negotiates the terms of the contract with them.

In relation to the particularities a TPF operation presents, the most diffuse procedure for this type of operation is the open procedure (the first one).

Because of the complexity of the TPF procedure, is furthermore usual in the PA case that third parts instruct the draft of the call for bids and the special specifications of contract. These can be company working in the field, of proved experience, or local energy agencies.

[7] Local Sanitary Agency