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"ST-ESCOs"

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

Intelligent Energy – Europe (EIE)

Type of action: SAVE

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ST-ESCOs Market Analysis: Hellas

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Abbreviations used:
ESCO: Energy Service Company
ST-ESCO: Solar Thermal ESCO
STS: Solar Thermal Systems
TPF: Third Party Financing
IRR: Internal Rate of Return

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1 Introduction to the Solar Thermal and ST-ESCOs market

Generally speaking, most of the market aspects concerning the Solar Thermal sector in general are relevant also for the ST-ESCOs market. This is because, apart from isolated users (e.g. single family houses), almost all other solar thermal applications represent potentially a market for ST-ESCOs[1]. In this report, after an introductory description of the solar thermal (and potentially ST-ESCOs) market, specific promising sectors for ST-ESCOs agreements are identified and their potential estimated. Moreover, an economic analysis indicates the feasibility of such agreements under various conditions. Additional information related to the current analysis is (or will be soon) available in the ambit of ST-ESCOs project. More precisely:

- Information regarding the procedures to be followed for ST-ESCOs contracts implementation is subject of the "**ST-ESCOs Guide**".
- Lists with identified actors (possible End users and stakeholders) are also available.
- A user friendly software for energy and economic analysis of ST-ESCO projects will be a valuable tool for ST-ESCO developers.

The most updated material concerning the above aspects can be found in the project's web site: http://www.stescos.org/.

The Hellenic Solar Thermal Systems market after almost 20 years of evolution and fluctuations could be considered as a developed market, at least regarding the residential sector.

Regarding the use of solar systems, almost 99% of them are small scale systems (thermosyphonic type) [ESTIF, 2003] for domestic hot water.

The rest of the systems are forced circulation systems and regard mainly large scale applications for hot water in the tertiary (hotels, hospitals and swimming pools) and the industrial sectors.

The most important reasons for the success of Solar Thermal Systems in Hellas are summarised below:

- High solar radiation, appropriate climatic conditions and morphology of the country.
- Successful marketing campaigns.
- Legislative support and incentives at early stage.

[1] This is obvious for end-users with a high hot water consumption (hotels, hospitals, sport centres, industries etc), but less obvious for the multifamily houses where, in Hellas, plenty of thermosyphonic units are installed, each one serving a single apartment. However, this existing situation does not exclude at all the potential for central solar thermal systems (and therefore for ST-ESCOs' installations) in the residential sector of multifamily buildings.

- Broad dissemination of the technology (advertisements, information brochures, demonstration projects, etc.).
- Public acceptance.
- Continuous effort from the manufacturers for better and cheaper products.
- Easy access to solar thermal products.

Despite the success of the solar thermal systems in the residential sector, there is still a large unexploited potential in it. Moreover, although the industrial and tertiary sectors represent a high potential they have a negligible penetration of solar thermal systems.

One of the main reasons for this unexploited potential is that end users (especially large ones) are still reluctant to face the high initial investment cost and doubtful for the reliability and durability of solar installations.

The **ST-ESCOs**, by **selling the solar energy (and not the solar plant)** at a competitive price and by carrying out the plant’s operation and maintenance can remove completely the above mentioned barriers, thus opening the way for a rapid expansion of solar thermal installations throughout Europe in all potential sectors (residential, services and industry), both private and public.

In fact, under the ESCO scheme, the contractor (ST-ESCO), undertakes the risk of completely financing the investment, which is paid off by long-term energy saving and/or energy supply and a reduction in operating costs.

The contractor provides a wide range of different resources, including manpower, technical expertise, project finance, operating experience and all the associated management and commercial skills. Since the contractor is responsible for operation as well as project implementation, performance guarantees are inherent in the approach. If the contractor does not provide the service (defined in terms of specific standards such as room temperatures and volumes of domestic hot water) he does not get paid, and indeed may be required to provide an equivalent service using an alternative facility at his own expense [Kanavos, 2001].

Despite the possibilities described above, the development of ESCOs in general is still in its infancy and, to what concerns in particular the solar thermal sector, only sporadic (and not always successful) initiatives have been taken.

The pure ESCO industry in Hellas may be considered negligible and stable for the present. The proposal for a directive of the European Parliament and of the Council 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 (Energy Performance Contracting) 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.

2 ST-ESCOs Market

Practically speaking, the ST-ESCO applications in Hellas are very few and there are no Energy Service Companies active in the market for the moment. Only a few ESCO attempts have been made in the past where Solar Thermal projects were involved. Apart from CRES, only two companies (SOLE LTD and SOL ENERGY HELLAS Inc.) have made efforts in order to act as ESCOs. Some of the applications regarded a mixture of Energy Efficiency and Solar Systems, thus resulting more attractive financially.

Additionally, some companies have expressed their interest to play a role in this field. These were mainly construction companies and suppliers of systems (Solar, CHP, Automations, etc) and their interest was mainly expressed within the framework of other CRES's projects regarding the development of the ESCO market. These projects were focused on the public sector where several Energy Efficiency measures were under consideration (including STS).

Regarding financing institutions, the most appropriate, to be a part of ESCO schemes, are of course banks or other similar institutions such as insurance companies. In some cases utility companies could also play this role.

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.

Some of the reasons for the weak development of the ESCO market in Hellas are the lack of the appropriate legal and institutional framework and various bureaucratic barriers. In what concerns particularly the public sector, a serious barrier was present until very recently: the law did not permit to a public institution to pay "alternative" energy bills like those from energy efficiency or solar thermal applications. Fortunately, this barrier is going to vanish, since a new law (that will permit such applications) has been implemented. The new law about "Agreements between Public-Private Sector (APPS)", facilitates joint projects between the public and the private sector that may boost the ESCOs market.

Some other barriers include:

- The missing of a legal consolidation of ESCOs.
- The project financing, investment, design, construction and insurance mechanism is not well defined.
- The direct economic benefits for the end-user become negligible if the ESCO needs high IRR or short contract duration.
- There is lack of technical knowledge and expertise between the possible ST-ESCOs developers in Hellas. The same lack of awareness and credibility exist among the possible end-users in what concerns the economic and other benefits connected to the solar thermal plants implementation.

During the last few years efforts have been made in order to determine ways to overcome these problems. Nevertheless, the situation in the private sector is more flexible and interest on realising ESCO projects, both from the demand and the supply side, does exist.

More information concerning the background of ST-ESCOs (including existing experience, barriers, opportunities, threats etc) can be found at the "Background Studies" that are available for each participating country and downloadable from the project web site (http://www.stescos.org/)

In the study of [Kanavos, 2001], the feasibility of TPF schemes (and ESCOs' creation) is examined for the industrial sector; however some of the results that are valid also for the services and the residential sector and are listed below:

- There is a remarkable theoretical techno-economic potential for solar water heating systems in Hellas.
- The "mutual benefit" TPF financing schemes are the optimum financing mechanisms that maximise the real potential.
- The establishment of an ESCO dealing with the promotion of solar water heating systems is absolutely feasible and constitutes a real market opportunity for a profitable business.

An ESCO, in order to grow healthy in the present Hellenic conditions should, among else, have the following characteristics:

- Excellent knowledge and wide expertise in solar water heating systems in order for the reliability of the relevant installations to be maximised.
- Good borrowing ability in order for low loan interest rates to be achieved.
- Deep knowledge of the mentality and other relevant characteristics of the Hellenic thermal sector.

3 Identification of relevant sectors

In the following text, once an overall demand description is made, each promising sector is examined and a potential for a 5 years period is estimated. In order to be as realistic as possible, it was assumed that this period may start from the year 2008 (after the completion of the EIE "ST-ESCOs" project); predictions may be valid only if by the year 2008 the solar thermal ESCOs will be appropriately promoted.

3.1 Overall market demand

At the end of 2004 the surface area of the solar collectors in operation in Hellas amounts to about 2.83 millions m^2 [ESTIF, 2005]. About 62 % of the total collectors' surface is located in Central Hellas, 28 % in Northern Hellas and 10 % in Crete which has the highest surface area per capita.

Propelled by an exceptional year in the replacement market, Hellas has edged Austria for second place in the EU's solar thermal market: 151 MWth of new solar thermal capacity[2] were installed in 2004 - an increase of 34% compared to 2003.

About 1.000.000 households are avoiding 1.800.000 ton CO2 each year by using a solar system which can provide up to 80% of the energy needed for hot water.

Although the above data show that in Hellas solar thermal technology is widely used, there is still a large potential. Less than 25% of the houses have already installed a solar system. The figure is very low compared with the potential, having in mind that in similar cases (Cyprus, Israel) the percentage is over 90%.

A wide market survey have shown that more than 90% of the owners of solar systems are satisfied and if they would replace the old solar system they would invest on a solar system again.

Main motivations to buy a solar system are the following:

- Savings (expected pay back period 4-6 years if the auxiliary energy source is electricity)
- Safety (compared with electric heaters and gas burners) and trouble free operation
- Improved quality of life (availability of hot water)

To buy a solar system in Hellas is as easy as to buy an electric heater. As the most roofs are flat, the installation is also easy (reasonable access to the roof, simple selection of the appropriate position/direction).

Most of the collective (central) systems (about 150.000 m^2) were subsidised by 50% and they are installed mainly on hotels or industries. The low oil price results to payback periods longer than 5 years and make the central solar system solution less attractive for the end users. However the sort term forecasts and the tendency for conventional fuels' price increase can favour renewables and in particular STS.

The main reasons for potential STS users to choose the services of an ST-ESCO company are:

- Difficulty to face the initial investment.
- Uncertainty regarding economical results of a ST system.
- Unwillingness to face the technical risks with respect the installation, operation and maintenance of a ST system.

The most promising sectors, in Hellas, for an ESCO to invest on application of Solar Thermal Systems seem to be the tertiary (services) and the industrial sector. The residential sector presents a peculiarity because in most of the cases the tendency is to install individual systems.

[2] Equivalent to about 216000 m^2 of collector area.

One of the reasons is that, even in the blocks of flats with central space heating, the DHW (domestic hot water) is not centrally distributed. In the future there might be a substantial market potential if certain legislative measures (metering, billing issues etc) will be taken towards the direction of central DHW systems.

The introduction of central ST systems in the multifamily building is a very important issue and could enhance substantially the solar thermal market. Efforts should be focused on new constructions as well as on building renovation. ESCOs establishment could help in this direction.

Based on the data from the National Statistical Service of Hellas, for the year 2000, building stock in Hellas accounts about 4 million buildings. From those, 2.756 million are households, 111 thousands are offices and commercial buildings (2.8 %), 414 thousands are mixed use buildings (10.4 %), 31 thousand are industrial buildings (0.8 %), 23 thousands are hotels (0.6 %), 17 thousands are educational buildings (0.4 %) and 2 thousands are hospital buildings (0.1 %). Other tertiary uses account 594 thousand buildings (14.9 %).

Regarding the tertiary sector the most promising sub-sectors for the application of Large Scale STS (and therefore of ESCOs contracts implementation) are:

1. Hotels
2. Hospitals
3. Care buildings
4. Sport Centers

Some existing and potential market data for selected sectors are following.

3.2 Hotels Sector

The hotels sector is most probably the most promising one for the future implementation of Large Scale Solar Heating plants (and, therefore, ESCOs contracts). Apart from having a large potential, it presents an already developed market. Consequently, a new solar company has simply to participate in this existing market while in other sectors with similar potential the market is weak or still has to be created.

Over 100 hotels have at present large or medium size central solar thermal plants, manufactured by 15 different constructors [Karagiorgas, 2001]. The average size of the central solar plants for hotels is 257 m^2, the largest one is sized 2783 m^2, and the total size is 28820 m^2. Figure 1 shows a size distribution of the central solar systems in the Hellenic hotels.

Here follow some selected elements of the available material for the solar hotel sector that can be interesting for the purposes of this analysis:

- The most developed market exists in the island of Crete. In fact, 41.40% of the market is met in Crete, only 2.10% in Northern Hellas, while the remaining 56.5% (15,285m^2) is spread across the rest of the country.

- It is estimated that thermosyphonic solar thermal systems installed in hotel units cover surfaces of 35,000 m^2. We can, therefore, reach the conclusion that they hold an equally significant share in the market of solar thermal systems.
- Although only 10 (thus 10%) of the hotels have collectors surface of more than 500 m^2, these systems hold a market share of 30.17%.

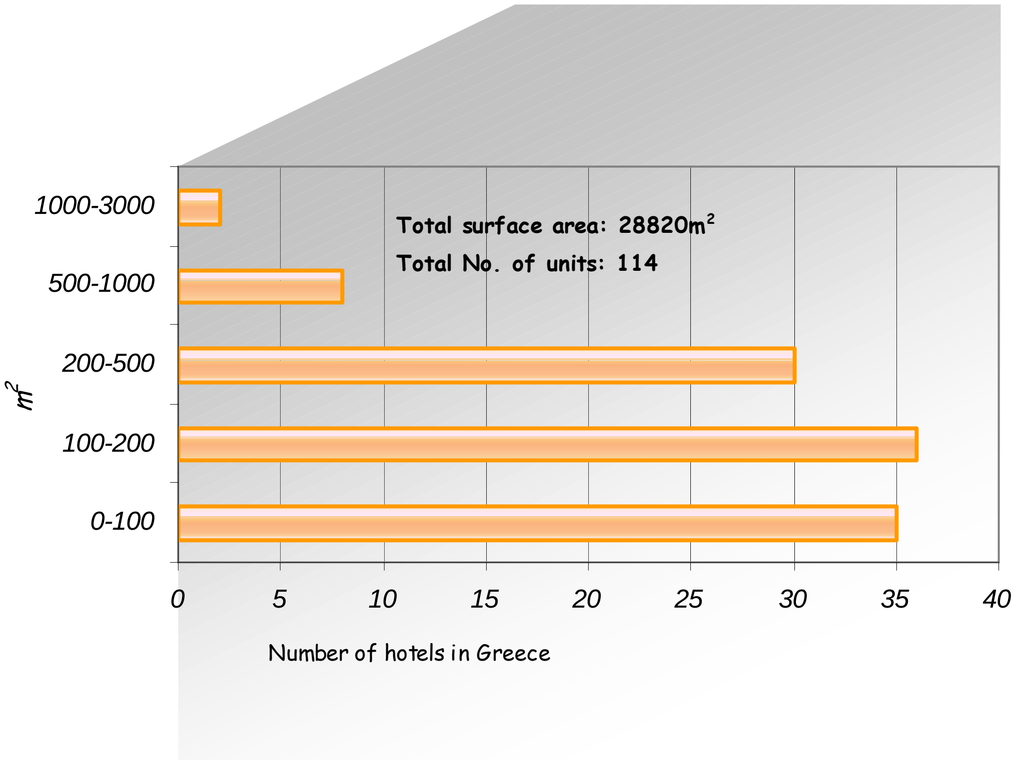

Figure 1: Size distribution of central thermal solar systems in Hellenic hotels [Karagiorgas, 2001]

Based on the data from the Hellenic Chamber of Hotels (2004), in Hellas there are 8,900 Hotels (all categories) with a capacity of 352,000 rooms and 668,000 beds. By making the hypothesis that there is a potential of 1m^2 of collector surface per each 2 rooms, it results that about 175,000 m^2 could be installed in the Hotel sector excluding the rooms for rent all over the country. This last category could double the above result, bringing the potential for the (enlarged) hotel sector to about 350,000 m^2.

For the moment, there have been installed about 29,000 m^2 without considering the systems installed in the rent rooms. The later could add up another 29,000 m^2.

Having a conservative approach, **for the 5 years** period, it could be estimated that **there is a potential** of ST-ESCOs implementations **equal to** the sum of the already installed systems, i.e. another **60,000 m^2** (this corresponds to about 17% of the total potential of the hotels sector).

3.3 Industrial Sector

In the possible solar **industrial applications** for hot water, four main industrial sectors can be distinguished, promising a good acceptance of large solar thermal systems. These are industries with relatively low energy consumptions, where the fraction of energy provided by the solar thermal system to the industry's energy load is quite significant. Solar thermal systems are particularly effective in industries that require water temperatures in the range 40 – 80 ^{0}C.

The most promising industrial sub-sectors for the application of Large Scale STS are:

1. **Food industry** (Dairy products, cold cut and process meat factories, pastry and cake confectioneries, olive oil refineries, tinned goods, slaughter houses)
2. **Agro-indusries** (Solar drying, horticulture-nursery greenhouses, slaughterhouses, meat processing, livestock landings)
3. **Chemical industry** (Cosmetics, detergents, pharmaceuticals, wax, distilleries)
4. **Beverage industry** (Wineries, liquor and wine distilleries, breweries, soft drinks)

In an extended analysis for the promotion of solar heating systems in the industrial sector [Kanavos, 2001], the technical potential for solar water heating systems has been estimated. The results, divided by industrial sub-sector, are presented in table 1 and practically confirm the above declarations on “good potential applications”.

CODE	Industrial Sector	Surface of solar collectors substituting DIESEL (m^2)	Surface of solar collectors substituting LPG (m^2)	Surface of solar collectors substituting LSHFO (m^2)	Surface of solar collectors substituting HSHFO (m^2)	Surface of solar collectors substituting NG (m^2)	Total surface of solar collectors substituting PETROLEUM FUELS & NATURAL GAS (m^2)
1	Iron and Steel	0	0	0	0	0	0
2	Chemical and Petrochemical	21,226	155,921	238,992	0	805,156	1,221,295
3	Non-Ferrous Metals	0	0	0	0	0	0
4	Non-Metallic Minerals	0	0	0	0	0	0
5	Machinery + Construction + Transport Equip.	17,689	1,834	11,006	0	25,878	56,407
6	Mining and Quarrying	0	0	0	0	0	0
7	Food and Tobacco	235,847	99,056	707,541	0	815,507	1,857,951
8	Paper, Pulp and Printing	31,839	55,031	148,584	0	183,961	419,415
9	Textile and Leather	29,481	4,586	377,355	0	444,179	855,601
10	Other Industry	749,994	333,855	69,182	1,572	334,903	1,489,505
	Total Industry	**1,086,076**	**650,283**	**1,552,660**	**1,572**	**2,609,583**	**5,900,174**

Table 1: Technical potential for solar water heating systems by industrial sub-sector

Legend: LPG=Liquefied Propane Gas, LSHFO=Low Sulphur Heavy Fuel Oil, HSHFO=High Sulphur Heavy Fuel Oil, NG=Natural Gas.

In the study of [Kanavos, 2001] the techno-economic potential for each industrial sub-sector in the case of the "TPF financing scenario" has been estimated. The results or this analysis are summarised in table 2.

Industrial Sector	**Surface of solar collectors substituting DIESEL (m^2)**	**Surface of solar collectors substituting LPG (m^2)**	**Surface of solar collectors substituting LSHFO (m^2)**	**Surface of solar collectors substituting HSHFO (m^2)**	**Surface of solar collectors substituting NG (m^2)**	**Total surface of solar collectors substituting PETROLEUM FUELS + NATURAL GAS (m^2)**
Iron and Steel	0	0	0	0	0	0
Chemical and Petrochemical	10,121	26,556	0	0	0	36,677
Non-Ferrous Metals	0	0	0	0	0	0
Non-Metallic Minerals	0	0	0	0	0	0
Machinery + Construction + Transport Equip.	8,434	312	0	0	0	8,747
Mining and Quarrying	0	0	0	0	0	0
Food and Tobacco	112,459	16,871	0	0	0	129,330
Paper, Pulp and Printing	15,182	9,373	0	0	0	24,555
Textile and Leather	14,057	781	0	0	0	14,838
Other Industry	357,620	56,860	0	0	0	414,480
Total Industry	**517,874**	**110,752**	**0**	**0**	**0**	**628,626**

Table 2: techno-economic potential for solar thermal TPF applications in industrial sub-sectors

We may assume that a realistic potential for ST-ESCOs applications in the ambit of the 5 years period is the 10% of the total potential presented on table 2, thus resulting to about 63,000 m^2.

3.4 Residential Sector

Only sporadic applications on central solar heating systems exist in the residential sector. The common practice is the use of thermosyphonic systems, even in multi-floor buildings. However, recently some of the active solar companies have expressed their interest in the application of forced circulation systems, mainly of small scale.

In fact, some changes are expected on this sector and some opportunities may arise in the short and mid term future. One important change is related to the new Regulation for Rational Use of Energy and Energy Conservation in accordance with the Energy Performance Building Directive (EPBD). This Regulation refers to the entire building sector and will change the Energy Concept of both existing and new buildings. Some aspects that may affect the utilisation of solar thermal systems especially in the residential sector are listed bellow:

- The Energy Design of any new building will be compulsory.
- The results of the Energy Design will be recorded on a special document, the **Energy Identification Sheet** of the building.

It is certain that the **Energy Identification Sheet** will affect strongly the building value. Consequently, the application of solar thermal systems will become an appealing option for the constructors of new buildings as well as for the owners of existing ones that are willing to improve their commercial value.

The annual sales, as already mentioned, are about 150,000 m^2, directed mostly to the household sector.

With the right strategies it could be safely said that about 10% of that figure, i.e.15,000 m^2/year, could be added to the ST-ESCOs potential. Consequently, in the 5 years term the ST-ESCOs potential in the residential sector is about 75,000 m^2.

3.5 Hospital Sector

Hospital sector counts almost 2000 buildings all over Hellas. Based on the data from the National Statistical Service of Hellas, in 1998 there have been 1.62 million of hospitalised people with almost 13.5 million man-days of hospitalisation (i.e. almost 8 days of hospital treatment per patient). Considering this figure as a typical annual value, and a mean hot water energy demand of 2.3 kWh per day and person, the resulting total demand for sanitary hot water is about 31 GWh/year. Considering a 70% coverage of this load by ST systems (~ 500kWh/m^2/year), the theoretical potential for solar thermal installations collectors is about 43,000 m^2. If we assume that a 10% of this figure could be covered by ST-ESCOs contracts in the 5 years period, the resulting potential is about 4,300 m^2. Nevertheless, ST-ESCOs projects for the hospital sector are directly related with the resolution of the problems for the public sector and the successful implementation of the Public-Private Partnerships.

3.6 Other tertiary sectors

Since no data are readily available, it has been assumed that the potential for ST-ESCOs applications for the remaining sub-sectors of the tertiary sector is another 4,300 m^2 (equal to the hospitals sector potential).

3.7 Summary table

Table 3 summarises the above estimations of the ST-ESCOs potential for the various sectors.

Sector	ST-ESCOs potential (collectors m^2) for the 5 years period	Corresponding thermal capacity installed (MW_{th})
Hotels	60,000	42
Hospitals	4,300	3
Rest of Services sector	4,300	3
Residential	75,000	53
Industry	63,000	44
TOTAL	206,600	145

Table 3: ST-ESCOs potential for various sectors.

4 Economic analysis for for ST-ESCOs implementations in Hellas

Usual terms for bank loans

Current (2005) interest rates for loans (for the order of magnitude of the solar applications) are about 6 to 6.5%. If we take out inflation, this interest rate becomes 3-4%.

CO2 Trade

The current (2005) conditions for CO_2 trade are at the moment not helpful for solar thermal systems applications. Only 139 Companies are included in the Hellenic National Allocation Plan (their installed thermal capacity has to be over a certain limit i.e. 15MW). There are no concrete possibilities for smaller Companies to participate into the CO_2 market at present.

Energy prices

Table 4 is a collection of energy prices for the main fuels used in Hellas.

Type	Price (VAT is included)	Source
Diesel	0,674 € /litre	Hellenic Ministry of Development
Diesel Heat	295 €/m^3	Hellenic Ministry of Development
LPG (Liquid Propane Gas)	507 €/tn	Shell Gas
Heavy Oil No1 (1500) HS	266 €/tn	EKO
Heavy Oil No3 (3500) HS	223 €/tn	Shell Hellas
Heavy Oil No3 (3500) LS	275 €/tn	EKO
Natural Gas	37,3 € /MWh	Attica's Natural Gas Company: DHW use (2005)
Natural Gas	28,1 € /MWh	Attica's Natural Gas Company: mean value for industrial use (2005)

Table 4: Prices for main fuels in Hellas (2004 and 2005)

Note: In all fuels the applied VAT is 18% except for natural gas, where VAT is 8%. The natural gas price has an additional component that is related to the power requirements of the consumer, equal to 0,203 €/kW. All prices are approximated and may vary according to the level of consumption and to the region.
It has to be noticed that the price of "Diesel Heat" can be applied exclusively for space heating purposes.

Financial Analysis for ST-ESCOs investments

In tables 5 and 6 some of the main economic parameters for possible ST-ESCOs investments are presented. Two types of solar thermal systems (medium and large) are considered. The following practical requirement has been adopted for the analysis: the price of the solar energy had to be (at maximum) equal to the lowest conventional price (that is here realistically represented by the natural gas prices of 2005 for domestic and for industrial users). Consequently, the IRR (Internal Rate of Return) of the ST-ESCOs investment has been calculated for various contract durations.

System type	Cost per m^2 (without support)	Subsidy	Typical Range	Typical energy production to final use (kWh/m^2)	Annualised price of solar thermal MWh	Conventional price of MWh (for natural gas)	Years of contract	IRR: Internal Rate of Return (over inflation)
Medium size ST system	320 €	50%	50-200 m^2	600	41,3 €	41,4 €	8	5 %
							10	**9 %**
							15	13 %
							20	14 %
Large ST system	280 €		500 to thousands of m^2	650	31,1 €	31,2 €	8	3 %
							10	**7 %**
							15	12 %
							20	13 %

Table 5: Main economic parameters for ST-ESCOs applications (50% subsidy)

System type	Cost per m^2 (without support)	Subsidy	Typical Range	Typical energy production to final use (kWh/m^2)	Annualised price of solar thermal MWh	Conventional price of MWh (for natural gas)	Years of contract	IRR: Internal Rate of Return (over inflation)
Medium size ST system	320 €	30%	50-200 m^2	600	41,3 €	41,4 €	8	-
							10	2 %
							15	7 %
							20	9 %
Large ST system	280 €		500 to thousands of m^2	650	31,1 €	31,2 €	8	-
							10	1 %
							15	6 %
							20	8 %

Table 6: Main economic parameters for ST-ESCOs applications (30% subsidy)

The main hypothesis for the calculations are listed bellow:

- Maintenance costs as well as costs for measuring, billing, relationship with clients etc. are supposed to be included (for simplicity) to the initial (investment) cost[3].
- In all IRR the inflation is not included (they are calculated as if inflation were 0).
- A combustion efficiency of the natural gas boilers equal to 90% has been assumed. This is the reason for the higher prices in tables 5 and 6 compared with table 4.

[3] In fact, the "cost" numbers used correspond to market prices (applied when the end-user purchases the solar plant). It is obvious that the real cost of the plant for the ST-ESCO will be lower.

- For table 5 a financial support of 50% has been assumed for the ST-ESCO: this is the current (2006) situation under the "Development Law".
- The Natural Gas prices have been assumed to follow the inflation rate for the duration of the contract (therefore, they remain stable since calculations are without inflation). The charging of power supply from the natural gas distributor has been ignored.

Comments on the results of Tables 5 and 6

From the comparison of the annualised prices between the "solar" and the "conventional" MWh, it is clear that the investment is attractive in the first case (table 5 - subsidy of 50%). In this case, a 10 years contract gives an IRR that is 7 to 9% over the inflation rate.

On the other hand, table 6 (with 30% support) shows that the ST-ESCOs investment is hardly attractive with a 10 years contract.

It is worth mentioning that, apart from the subsidy percentages, most of the other hypotheses done are on the "safe side". For example, the 90% of the gas boilers efficiency (based on the upper calorific value of the natural gas) is particularly high; lower values may occur in practice. Moreover, natural gas is the cheapest conventional fuel at the moment. Diesel oil, for example, is by 20% more expensive if compared with natural gas thus making an ST-ESCO application more attractive in economic terms.

The above analyses have shown that long contract duration is a necessary condition for the success of an ST-ESCO agreement. Moreover, the importance of subsidies is evident.

5 Best practice examples

The example of Mevgal Dairy industry is presented here. Best practice examples (for all participating countries) can be found in the site http://www.stescos.org/.

General Presentation

The project regards a TPF action in "Mevgal S.A." industry for a solar thermal application combined with a heat recovery measure.

Mevgal S.A. is a dairy industry situated in Northern Hellas (between Thessaloniki and Giannitsa).

The heating requirements (mainly for pasteurisation and cleaning) are covered by a steam network. The steam boilers are running on heavy oil and are fed by cold water; daily water requirements are about 75 m^3.

Technical Aspects

The total collectors' area is 727m^2. A combination of three collector types has been used: selective flat plate (403m^2), black painted flat plate (216m^2) and 108m^2 of CPC (Compound Parabolic Concentrators).

The heat produced by the collectors' filed is used to preheat the water feeding the steam boiler. Two accumulators are used with a total volume of 10 m^3.

The mean annual value for the total solar gain is about 270 MWh.

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.

Contractual aspects

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. The system is in operation from 1999. 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).

Source: CRES internal reports, G. Kanavakis (MEVGAL project's responsible).

6 References

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Annex (Solar thermal systems technology used in Hellas)

Solar industry represents a well-developed manufacturing sector in Hellas. The Hellenic Solar Industry Association counts 18 members, which represent the larger manufacturers. Besides, about 50 smaller enterprises are active on a local or regional level. Hellas is the largest exporter of solar systems in Europe. The Hellenic production of the sector covers a substantial percentage of the European market.

Applied Technologies of Solar Thermal Systems

Since the great majority of solar sanitary hot water systems installed in Hellas regards compact thermosiphonic units, providing hot water to individual dwellings, it is worth describing them. A typical configuration of such a system comprises a simple flat plate collector (single glazed) and a storage tank attached above the collector. Usually, the heat is transferred from the collector to the storage through a closed circuit, filled with antifreeze fluid, and a heat exchanger. The storage tank is equipped with an electrical heating element. The system sizing is based on the estimation of daily warm water consumption per person of about 50 Litre at 50°C. The average area installed per apartment is 2–2,5 m² with a tank of 150-200 litres and the average solar fraction for the generation of sanitary hot water of these thermosiphonic systems is about 70–85 %. Typical price is around 1000 €.
Figure 2 is a schematic representation of a typical thermosyphonic system.

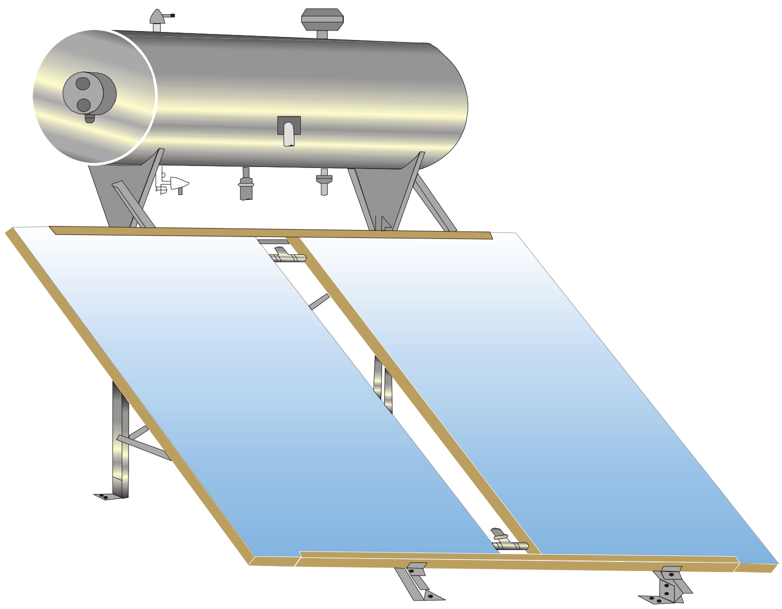

Figure 2: a schematic representation of a typical thermosyphonic system in Hellas.

In spite of the large unexploited potential, very few central solar systems are installed in Hellas. This is the case both for small size (single-family houses) as well as for large solar systems (building blocks, tertiary sector, industrial users etc.)
The main characteristics of the collectors' technology adopted in Hellas are listed bellow:
Collectors Surface 1.5 to 8 m^2

Absorber material:

Steel or stainless steel rollbond
Aluminium or copper bonded on copper or galvanised steel tubes
Copper bonded on copper tubes
Copper welded or soldered on copper tubes

Surface treatment:

Black paint
Selective paint
Selective surface

Insulation:

Many variations starting with Glasswool 30mm to combined hard PU-CFC free + rockwool totally 70mm.

Transparent cover:

Normal window type glass 3-4 mm
Solar tempered glass 3-4 mm
Plastic

Casing:

Aluminium extruded (anodised or polyester painted)
Formed Aluminium or steel sheet
ABS