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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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Authors: Luca Colasuonno, Mario Motta

Dip. Energetica, Politecnico di Milano

Piazza Leonardo da Vinci 32, Milano

20133 Italy

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1 Introduction

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. 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 main conditions at the moment are related to:

- Low diffusion of solar thermal technologies, for production and installation.
- Lack of know-how around solar thermal technologies, in particular about medium and large scale plants. This means a "young" solar thermal market, small size oriented.
- Great interest around the technology (a significant growth of ST installations rate is present).
- Development of new contractual form for the energy service contracting, in public and private sectors. And consequently new enterprises are growing, in order to provide these services.
- An inadequate level of knowledge of financial institute, to allow the development of the ST-ESCOs sector, even if the previsions of a high potential market are starting a new interest on the sector.

This document start from consumption data at macro level, divided for users sector. Starting from a qualitative and quantitative analysis of statistical data of thermal energy, under some hypotheses a prevision of the potential market for solar thermal installations is provided. All these analysis show a really huge potential, for any considered sector.

The role of ST-ESCOs is central for the realization of this potential. In fact

- Acquiring the know how for large scale solar thermal plants they can really open a new important branch of energy market;
- by selling the solar energy (and not the solar plant) and by carrying out the plant's operation and maintenance, the end users have no worry about the financing a managing the plant;
- specializing in the sector, they can develop really efficient systems, in term of technological reliability and contractual terms.

The ST-ESCOs actual market is really negligible, but the diffusion of the trend mentioned (increasing of interest in ST technologies and development of tool for energy contracting) are indicating a new way for energy management, where ST-ESCOs can be relevant actors.

2 Solar Thermal ESCOs Market

The application of solar thermal technologies to the energy service business in Italy is at the moment irrelevant. The lack of experiences in this field has two main causes:

- The Italian solar thermal market, that experienced significant grow rates in the past two years, is still at at a low level in absolute terms (number of installations).
- The new Italian ESCO's market (supported by the "white certificates" mechanism), apart for the big players active in public sector for two decades, is at the moment mainly focusing on electricity production.

2.1 Solar thermal market

According to ESTIF, which published one of the most comprehensive collection of data about the Italian solar thermal market, the total installed stock in Italy in 2004 was about 311.000 kW_{th}. This value is worked out assuming that almost all the plants installed until the beginning of the nineties are not anymore in operation. Following the trend of the last years in 2006 the installed capacity of solar thermal glazed collectors will be about 52.500 kW_{th}.

In Figure 1 the yearly installed capacity in the last twenty five years is presented. As shown in Figure 1 the Italian yearly installed capacity is still far lower than in the other European countries (about 4% of the European market). Nevertheless the growth rate of the last ten years is significant, and, maintaining the trend, the capacity installed in 2006 would be about 52.000 kW_{th}.

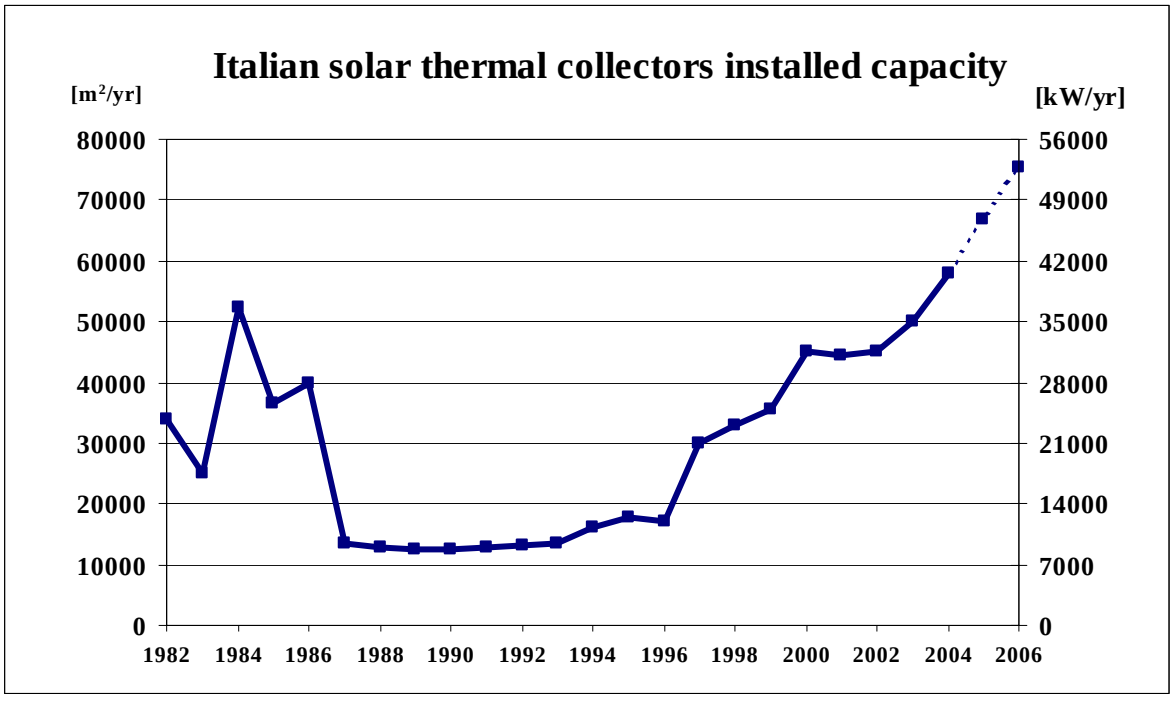


Figure 1: Development of collectors market in Italy. Source: [ESTIF 1 and ESTIF 2]

Most of the solar plants installed in Italy (more than 90%) is constituted by small scale installations (below 21kW, 30 m^2), used for mono or bi-family houses. Among these, the most common ones are plants for the production of domestic hot water (DHW)only. The market is dominated by flat plate solar collectors, but the evacuated tube collectors market share is growing.

According to a recent market study [ESTIF2], in Italy there are about 50 - 60 distributors of solar thermal technologies. The eighteen national producers (small and middle enterprises) cover about 20% of the local market. The sector directly gives occupation to about 300 people and, in 2000 had a turnover of 20 million euros. A greater share of the market is occupied by the Italian branches of foreign manufacturers, coming mainly from Australia, Germany, Austria, Greece and Israel.

The introduction of ST-ESCO concepts in Italy could have effects at different levels as mentioned further:

- The Italian solar thermal market is mainly constituted of small and medium capacity plants. The market of large scale plants is at a ridiculous level, due to lack of technical know-how and information about the benefit and economy of scale. The introduction of large scale systems would create the chance for know-how acquisition and training of installers, technicians and planners.
- Large scale plants have to be installed using large collectors, which result in a better energetic performance and lower installation costs. This issue is even more important for ST-ESCO applications where the economical efficiency of the project can be strongly influenced by the reduction of the investment. At the moment few are the systems based on large modules installed in Italy and not significant is their share of the market. The systems installed use modules manufactured abroad. The diffusion of the ST-ESCO concepts could help the growth of the large modules market, pushing the local producers to introduce among the products offer large collector modules.
- Italy represents one of the European markets with the highest potential and national and international solar companies are showing a growing interest towards acquiring or enlarging their market share. As consequence it is possible to foresee the enhancement of the competition resulting in higher technological standards and lower prices in the next few years. The reduction of prices (about 5% higher than European average) and higher technical quality both would contribute to enhance the feasibility and convenience of ST-ESCOs projects.

2.2 ESCOs market

The Italian ESCOs scenario is quite peculiar and the number of theoretical actors extremely large as consequence of the law (DM 20/07/2004) which introduced the Energy Efficiency decrees (i.e., white certificates). In order to implement the decrees the Italian Authority for Electricity and Gas (AEEG) adopted a mechanism for recognition of the companies which could play the role of ESCO. Being the criteria for the registration not based on the actual company business, but only on the document which formally constitutes the company, the large number of companies registered by the AEEG are not all really acting as ESCOs. For better understanding the ESCOs market, during this project, a survey has been carried out. In the Annex 1 is presented a summary of the survey's results. The main outcomes are listed further:

The majority of the companies are small and medium enterprises:

- about 70% has less then 15 employees. Many employ freelance professionals contracted on single projects. (considering freelancers and employees, the 60% of ESCOs has less than 30 workers);
- the average turnover is below 2.500.000 €/ year for 80% of the recorded ESCOs.

Their customers are mainly Public Administrations (21%), Small and Medium enterprises (21%) and Industry (19%). Still at a low level, but with the higher growth rate, is civil sector (both tertiary and residential).

Less than 50% of the Italian ESCOs already implemented projects dealing with renewable energies and about 10% already realized some solar thermal installations (mostly little plants, less than 15 m^2). Most of the ESCO applications are related to electricity, both end-use efficiency and generation (see also IEA DSM). In fact the most economic area of ESCOs interventions regards electric components (in particular re-powering of electric engines and lighting, in the public and private sectors). Regarding heat energy services, the main share of the market are large users (mostly public administration and hospitals), where the refurbishment of thermal plants and the installation of co-generators are the most implemented actions (due to high cost-efficiency).

A great barrier still present for this market development is the definition of a minimum level of services provided by the ESCO, for a precise legal consolidation of ESCOs. At the moment the Authority has started a section dedicated to ESCOs, as an action to support and develop the Energy Efficiency decrees (DM 20/07/2004).

Analysis of the relevant sectors

In order to carry out a sensitive assessment of the potential of the ST-ESCOs market in Italy, a demand side analysis of the energy sector has been carried out.

In this section the energy market in Italy is analyzed sector by sector. The typical consumption profiles at macro level, based on statistical data [ENEA] have been analyzed in order to highlight the ST-ESCOs potential applications. The different assumption taken for any specific sector are described in the following sections as the calculation methodology.

The demand side analysis at macro level has been carried out in detail for the following sectors:

- Residential;
- Tertiary and services;
- Agricultural;
- Industrial.

2.3 Residential sector

In Italy, the residential sector accounts to a share of the energy consumption in primary energy terms similar to the other OECD countries. It is mainly characterized by two important aspects [EP-IEA]:

- it covers about the 20% of the total national final energy consumption;
- a significant growth rate is foreseen (22% from the level of 2000 by 2010).

Residential consumption accounts for about 30 Mtoe and has been growing slowly at around 1% per annum since 1990. The data for 2002 indicate a consumption of about 27,8 Mtoe. [ENEA].

The application of solar thermal technologies in the residential sector is limited to space heating and DHW production. Even if solar cooling applications could have a potential in the last twenty years, have not been taken into account. Therefore from the data available in literature, and presented above, the portion of consumption suitable for solar thermal applications has been extracted. A summary of the energy consumption by source for the space heating and DHW production in the Italian residential sector is given in Table 1. The most used fuel is the natural gas (about 60%), followed by oil products and electric energy (about 20% each). It’s important to notice that if natural gas has reached the market saturation, in terms of diffusion on the territory. The other sources are mostly used in areas where methane-pipelines are not present, and a significant fossil fuel’s tax reduction is often applied.

Particularly important for this analysis is the breakdown of the consumption: heating (67% of the total) and DHW production (12%).

In order to complete the potential analysis it has been necessary to assess which part of the final use consumption is related to buildings suitable for solar thermal systems installations. From a survey on the existing Italian building stock database, it has been possible to assess the potential feasibility of solar thermal installations in the residential sector. The total number of dwellings in Italy results

about 21.5 millions [SOLARGE]; Figure 1 shows their distribution for typology (divided into building structure and building age).

Year	2002		
	Total	Space heating	DHW
Electric energy	5.414	138	960
Natural gas	15.842	12.798	960
Oil products total	5.457	4.639	326
LPG	1.790	1.165	133
Heating oil	3.565	3.375	190
Combustible oil	102	99	3
Carbon	15	15	0
Biomass	1.062	1.062	0
Total	**27.791**	18.653	3.288

Table 1: Final use energy consumption by source for space heating and DHW in the Italian residential sector (ktoe); source ENEA,

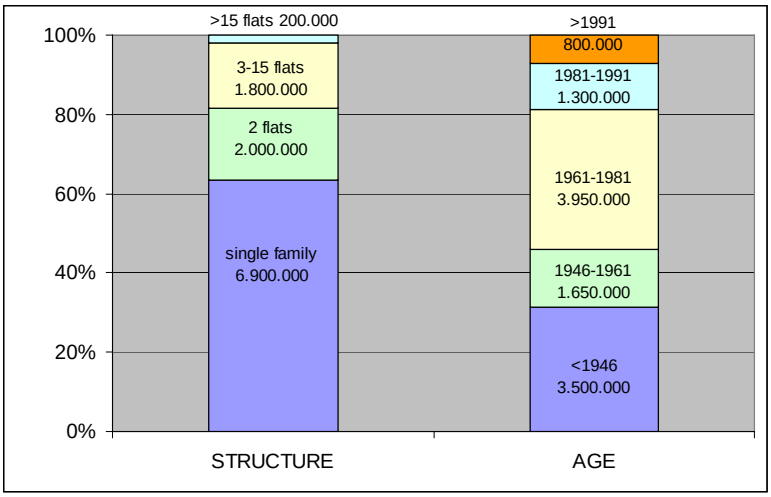


Figure 1: distribution of flats for typology of building

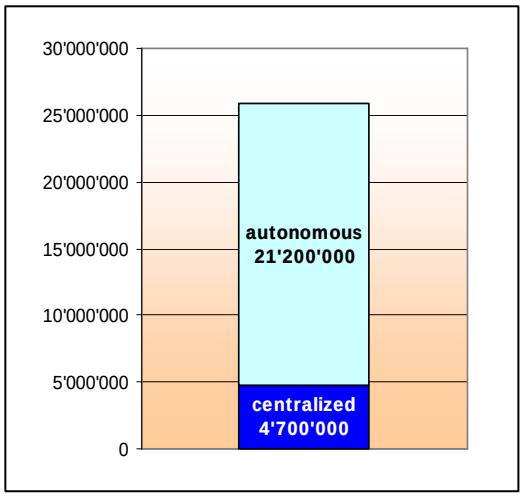


Figure 2: heating system in Italian flats

Among the Italian dwellings, more than 80% employ an autonomous heating system, as shown in Figure 2. Among these many are the installations which provide the heating of only a part of the flat/single family house. For what multi family houses (MFH) concern, centralized DHW and space heating systems are rare in Italy. The most common solution is to install a centralized space heating system and autonomous boilers for DHW in every single apartment. Rarely the hot water preparation is split in two different plants, one for the kitchen and one for the bathroom.

Therefore the number of buildings where it could be feasible to install a solar thermal plant for space heating and/or DHW production is a small percentage in comparison to the building stock. Neverthanless the absolute number of suitable buildings (multifamily buildings, such condominium or row houses, with a centralized solar system for both DHW and heating) would be sufficient for

significantly large diffusion of solar thermal in residential sector, and so a great potential energy market.

Below is presented an analysis for ST-ESCOs development in residential sector. It has been considered the installation of a solar thermal plant on any new MFH (with more than 9 lodgings) built. It's assumed a number of new buildings in ten years as in the 1991-2001 decade, as shown in Table 2.

typology number of lodgings	**Number of buildings**		**1991-2001 analysis**	
	1991	**2001**	**New buildings**	**growth rate**
single	7'578'575	6'924'714	-653861	-8.6%
2	1'732'655	2'280'428	547773	31.6%
3/4	717'833	1'031'757	313'924	43.7%
4-8	513'335	517'100	3'765	0.7%
9-15	261'838	275'263	13'425	5.1%
> 15	146'242	207'333	61'091	41.8%
Total	**10'950'478**	**11'236'595**	**286'117**	**2.6%**

Table 2: estimation of new building suitable for ST-ESCOs market; Source: elaboration on ANACI-CENSIS data

Following the methodology described in Annex 2, heat consumption has been estimated and shown in Table 3.

			heat consumption (kWh)		**solar potential (kWh)**	
Flats (x1000)		total surface (m^2)	**total**	**DHW only**	**total**	**DHW only**
minimum value	1'037,2	96'458'670	6'269'813'550	1'929'173'400	1'567'453'388	964'586'700
average value	1'382,9	128'611'560	8'359'751'400	2'572'231'200	2'089'937'850	1'286'115'600

Table 3: estimation of heat consumption for new MFH buildings

Present potential market[1]

The solar potential market is presented in Table 4

		Flats minimum value		**Flats average value**	
		combi	**DHW only**	**combi**	**DHW only**
installable collectors	kW	457'174	281'338	609'565	375'117
	m^2	653'106	401'911	870'807	535'882
producibility	kWh	391'863'347	241'146'675	522'484'463	321'528'900
avoided emission	annual ton of $CO_{2\ eq}$	97'966	60'287	130'621	80'382

Table 4: solar thermal potential estimation, for new residential building

[1] The calculation methodology is shown in the Annex 2

2.4 Tertiary sector

The tertiary sector includes all the activities connected to the service provision sector, both the commercial ones, as trading, hotels and restoration, credit and insurances, communication; and the ones linked to the public administration. The energy consumption of this sector presented a significantly high growth rate and increasing in absolute terms of about 30% from 1990 to 2002. The final energy consumption in the tertiary sector has been, in 2002, 12,1 Mtoe, which correspond to the 9% of the total national primary energy needs. Details and the breakdown for sources are given in Table 5.

This sector, together the residential one, is the main one for the potential ST-ESCo development.

		2002	**1990-2002 trend**
Electric energy		5.917	77%
Natural gas		5.079	19%
Oil products total		1.121	-32%
	LPG	315	60%
	Heating oil	580	-50%
	Combustible oil	226	-14%
Carbon		1	-95%
Biomass		0	
Total		**12.811**	37%

Table 5: Energy consumption in tertiary sector for source (ktoe); source: ENEA, 2002

The official statistics do not give any information about the breakdown of the total energy consumption among the sub-sectors composing the tertiary activities. By using indirect information it has anyway been possible to draw an evaluation of the consumptions, as shown in Table 6.

	2002 value	**1999-2002 trend**
Commerce	2.184	6,0%
Hotel, restaurant and bar	2.872	-2,0%
Communication	1.976	3,0%
Finance	478	-5,0%
Informatic, research and other	490	18,0%
Public Administration	761	-7,0%
Instruction	432	-7,0%
Health and social services	1.163	-7,0%
Other public services, social and personal	1.76	8,0%
Total	**12.117**	2,0%

Table 6: Distribution of energy consumption in tertiary sub-sector (ktoe); source: ENEA

The principal sub-sector are hotels and restaurants. But for what hotels concerns, it has to be pointed out that they mostly benefit from a strong reduction of taxes on the natural gas (where these contribute normally to the 50% of the gas final price). In these conditions, thermal solar plants often obtain very long pay back time.

Although at the moment very little exploited, this sector is especially suitable for the development of the solar thermal technology:

- low temperature utilization, required all over the year;
- availability of surfaces;
- furthermore it is going on a boom of tertiary buildings, both new ones and restructured (where an architectural integration is possible).

And above all, in a middle-long term analysis is a crucial basin for the application of solar cooling plants.

The most suitable typologies are:

- school multiservices complexes, that can guarantee a continuous use also in summer;
- swimming pools;
- sporting centers;
- distribution centers.

The whole tourist sector, in particular hotels and camping along the Italian coast, are another key group. Surprisingly, the thermal solar plants are indeed an exception in this sector; even if a distortion of the market is given by the above mentioned tax reduction.

	Installable collectors		**producibility**	**avoided emission**
	kW	**m^2**	**kWh/yr**	**annual toes of $CO_{2\,eq}$**
electric energy	13'446	19'209	13'446'383	8'068
natural gas	608'210	868'872	608'210'250	162'189
LPG	37'721	53'888	37'721'250	13'472
oil	69'455	99'221	69'455'000	32'056
combustible oil	27063.47	38'662	27'063'500	12’490
carbon	119.77	171.1	119'750	99
Total	**756'016**	**1'080'023**	**756'016'133**	**228'376**

Table 7: tertiary - estimation of sectorial solar thermal potential

Present potential market[2]

For tertiary sector has been considered all thermal uses; in particular the considered base data are the all consumption by fossil fuels and the 5% of electric consumption. While the sector is so wide, the only 1% of these consumptions was considered for the evaluation of potential substitution.

Table 7 shows the substitution potential for each energy source.

2.5 Agricultural sector

The agriculture (and fishing) sector covers about 2,3% of the total national final energy consumptions. Since 2001 it accounted for about 3.300 ktoe, slightly changing year by year (see Table 8).

[2] The calculation methodology is shown in the Annex 2

		2002 value	1999-2002 trend
Electric energy		421	4%
Natural gas		121	1%
Oil products total		2'629	1%
	Combustible oil	1	-92%
	Petrol	34	-48%
	Oil	2'521	3%
	LPG	74	-6%
Carbon		0	
Biomass		126	-6%*
Total		**12'205**	**31%**

*2000 data

Table 8: Agriculture and fishing energy final consumption (ktoe); source: ENEA

As regards the composition energy sources utilized, the percentage of oil products on the total remains widely preponderant (about 80%), due above all to automotive uses. In absolute terms, the consumption of oil products is evaluated in more than 2.600 ktoe/year since 2001.

It's furthermore estimated that the natural gas utilization has reached a saturation threshold; hardly there will be a significant increase of rural methanized areas.

Renewable sources show a gradual increase starting from the first 1990s, owed to the increasing use of biomass for heating services. Important data, because the driving forces of the sector are related to the joining of 'cost and environment'. The diffusion of biomass heating plants is a very positive phenomenon, also for the solar thermal: the integration between solar and biomass can easily guarantee a complete self sustainability for thermal uses, and improves the working conditions of the single plant, involving a significant reduction of the costs.

Furthermore this available energy can be easily used for:

- DHW production;
- Space heating;
- Accessory services, like pre-heating in desiccation processes of agricultural products.

The contact with consortiums or agricultural cooperatives, instead of single companies or farmers, can be an important element in the diffusion of the solar thermal; in particular if the integration of the solar energy is foreseen in a wider analysis, for the management of the entire process of biomass production and utilization.

Present potential market[3]

Also for agricultural sector all thermal uses have been considered; in particular the base data are the total consumption of fossil fuels (except for oil, where the 5% is considered) and the 30% of electric consumption. The potential considered foresees the substitution of the 10% of these consumptions.

[3] The calculation methodology is shown in the Annex 2

The sector is characterized by a low level of consumption, but the solar thermal installation potential (Table 9) is still significant.

	Installable collectors		producibility	avoided emission
	kW	m^2	kWh/yr	annual toes of $CO_{2\ eq}$
electric energy	176'452	252'074	151'244'250	90'747
natural gas	169'465	242'093	145'256'750	38'735
LPG	102'965	147'093	88'255'750	31'520
oil	176'033	251'475	150'885'000	69'639
combustible oil	0	0	0	0
biomass	176'033	251'475	150’885’000	-
TOTAL	**800'947**	**1'144'210**	**686'526'750**	**230'641**

Table 9: Agriculture - estimation of sectorial solar thermal potential

Source / Sector	Solid fuels	Natural gas	Oil	Electric energy	Total	% of the sector
Metallurgy	2'989	1'899	112	1'711	6'711	17,2%
Mining	1	27	45	92	166	0,4%
Non ferrous metal	7	385	85	481	957	2,5%
Mechanic	47	2'212	787	2'241	5'287	13,5%
Agro industry	49	1'846	791	1'063	3'749	9,6%
Textile and clothing	1	1334	451	1'070	2'855	7,3%
Construction materials	531	1'057	2'367	734	4'689	12%
Glass and ceramics	0	2'544	367	497	3'407	8,7%
Chemistry & oil	13	2'921	1'029	2'296	6'260	16%
Paper	2	1'645	188	901	2'736	13,4%
Other manufactures	47	842	587	588	2'063	5,3%
Buildings	0	0	51	114	165	0,4%
Total	**3'687**	**16'710**	**6'859**	**11'788**	**39'044**	**100%**

Table 10: Industry - Final energy consumption for sector and source (ktoe), source: ENEA, 2002

2.6 Industrial sector

The Italian industrial sector energy consumption has been growing constantly in the past years, in spite of a progressive and remarkable decreasing of energy intensive activities. Details and the breakdown for sources are given in Table 10.

Also in this sector there is a strong prevalence of natural gas and electricity. Considering low energy intensity productions, it is possible to affirm that fossil fuels are completely destined to heat production.

Studies on potential of solar thermal energy in this sector (see EU POSHIP project), refers that about 50% of the industrial energy demand is for heat production, at low (<60°C), medium (60-150°C) and medium-high (150-250°C) temperature range. A very high percentage of the heat demand in the low and medium temperature range is found mostly in food and paper industries, less (but significant) in textile and chemical. These industries require more than 50% of their total process heat in the temperature range up to 200 °C.

However the costs factor is a crucial issue in this case. The liberalization of energy market and, often, the size of the companies, carry to individual contracting for the energy cost, economically very much favourable. Furthermore, interventions for the rationalization of productive processes (with a very high potential for heat recovery) and the installation of co-generators are rather diffuse, largely in companies with high consumption (of both electric and thermal energy) and careful for the quality of energy utilization. The economic comparison of solar thermal technologies with these is often very favourable with the last ones.

Emission trading can be interesting for solar thermal sector's development. The strong limit is the low 'returns' of collectors in terms of avoided CO_2, even if the solar thermal support in this case is really limited, if considering a single plant. More interesting are larger solar plants, considering that 1 ton/year of CO2 is avoided by 8.5 m^2 of collectors (while substituting methane).

For a first estimate, studies from the POSHIP project have been used, that define the potential heat from solar thermal in the more promising sectors.

Using data elaborated by POSHIP project, the following heat use profiles at low and middle temperature have been considered. Figure 3 shows the heat demand in the analyzed industries, grouped by industrial sub-sectors, and the fractions of the heat demand at low and medium temperature. In all the analyzed sectors (except for paper industry), more than 60% of the heat demand is at temperatures below 160°C, and in several sectors nearly all heat is consumed at temperatures below 60°C.

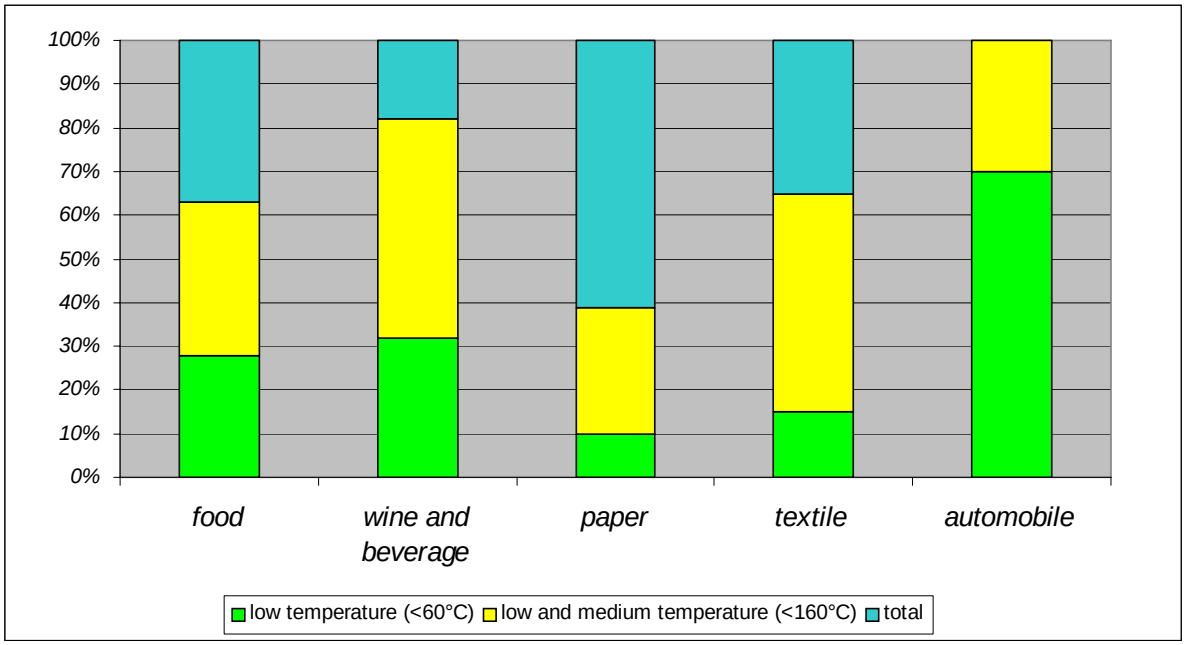


Figure 3: Distribution of the heat demand by temperatures, grouped by industrial sectors. Source: POSHIP.

Present potential market[4]

[4] The calculation methodology is shown in the Annex 2

The evaluation of the sector presented in Table 11 has been done under the hypothesis from POSHIP document.

	installable collectors		**producibility**	**avoided emission**
	kW	**m^2**	**kWh/yr**	**annual toes of $CO_{2\,eq}$**
food	908'051	1'297'216	778'329'545	205'565
textile	523'284	747'549	448'529'545	115'278
paper	625'223	893'176	535'905'682	138'341
chemical	165'428	236'326	141'795'455	34'567
TOTAL	**2'221'987**	**3'174'267**	**1'904'560'227**	**493'751**

Table 11: Industry - estimation of sectorial solar thermal potential

2.7 Conclusions

The simulated values for ST applications show interesting potential in any of the sector considered.

This great potential on solar thermal side is due to:

- high level of consumption, in absolute value;
- a significant portion of final use is related to thermal energy at low or medium temperature;
- the consumption level does not seem to decrease in the next decades.

The remaining barriers, in technological terms, are related to the complexity of the installation (if compared with conventional technologies, in particular in retrofit interventations) and its perception from the end-user. So, great potential is referred to new buildings and renovation, in any of the mentioned sectors.

On the tourist sector, in the next future great relevance can have the hotels (220’000 buildings) and the renovation of agricultural buildings (the sector counts 450’00 buildings, with a high share of new utilization for tourist accommodation, the so called “farm holiday”)

In the industrial sector, the integration of solar plant as a part of energy efficiency projects can be a great driving force, also for its “environmental friendly image”.

3 Economic analysis for ST-ESCOs implementations

3.1 Conventional energy prices

In Italy the view of the prices has continuously been changing in the last few years. This has happened thanks to the energy market liberalization which has abolished the monopoly and has promoted the entry to the market of new and important actors. The effect is the possibility of various costs of energy, according to the actors involved. In private negotiation, in fact, it is a possible treating price much lower than normally known.

Electric energy: the effect of the improved efficiency of the plants is widely opposed by the load of taxes put on the sale tariff. The perspectives of considerable increases in electric loads, together with the growing of oil price, have made foreseen a trend of constant increasing price for electricity. A part from a strong effect derived from the definitive liberalization of the market.

domestic use		consumption class (kWh /yr)				
		600	*1200*	*3500*	*7500*	*average*
2003 data	end user price	9,6	10	19,8	19,3	14,7
	without taxes	7,8	8,1	14,7	14,3	11,2
pecentual variation 2000/2003	end user price	14%	14%	-6%	-1%	5%
	without taxes	4%	4%	-11%	-6%	-2%

industrial use		consumption class (GWh /yr)				
		0,05	*0,16*	*2*	*10*	*average*
2003 data	end user price	14	12,8	11,7	11,1	12,4
	without taxes	10,4	9,4	8,4	8,5	9,2
pecentual variation 2000/2003	end user price	-2%	14%	17%		10%
	without taxes	-17%	-2%	-1%		-7%

Table 12: electricity prices, for typology of consumption (c€/m^3) (source: ENEA)

Natural gas: despite of the almost total dependence on importations, the growth of the cost of the methane is limited by the opening of new and important supply contracts.

domestic use		consumption class (GJ /yr)			
		8,37	*16,74*	*83,7*	*average*
2003 data	end user price	59,8	54,6	66,1	60,2
	without taxes	48,6	43,9	38,6	43,7
pecentual variation 2000/2003	end user price	8%		2%	5%
	without taxes	8%		3%	6%

industrial use		consumption class (GJ /yr)			
		418,16	*4186*	*41860*	*average*
2003 data	end user price	41,2	35,9	24,6	33,9
	without taxes	35,6	30,8	20,7	29,0
pecentual variation 2000/2003	end user price	8%	30%	12%	17%
	without taxes	-2%	19%	4%	7%

Table 13: natural gas prices, for typology of consumption (c€/m^3) (source: ENEA)

Other fossil fuels; in this case, to the dependence from importations is added a poor activity on creation of new infrastructures (due to the progressive reduction of fuel fossil market shares). Here the reduction of the taxes (in which are significant the discounts for uses in not methanized areas) is an element important to mitigate the rise of the price.

Reference year: 2004 - €/ton, or €/1000 lt -	Heating oil	909.9
	Combustible oil	232.3
	LPG	531.1

Table 14: Fossil fuels: Reference prices; Source: MICA

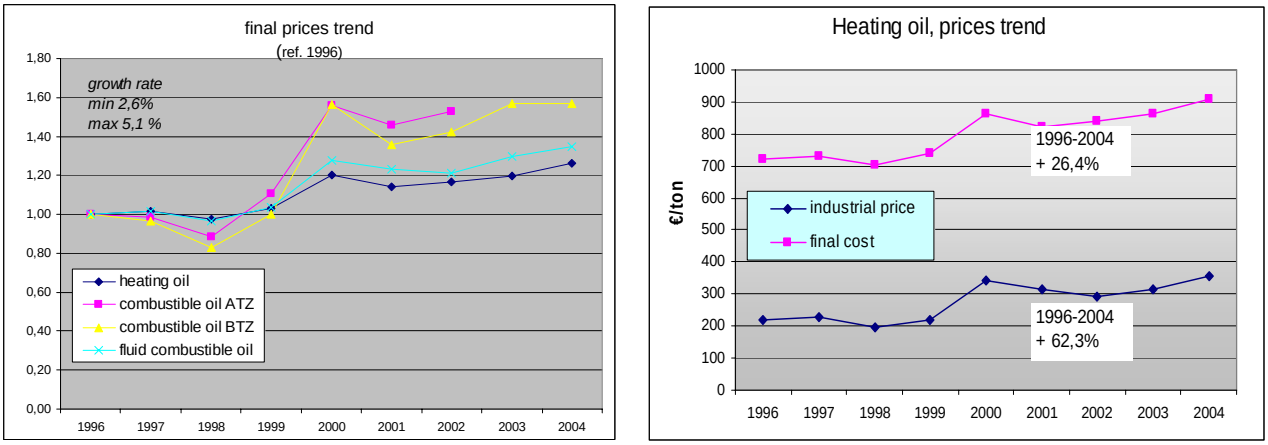


Figure 4: Fossil fuel price trend, source: AUEN

3.2 Financial Analysis for ST-ESCOs investments

In this chapter a short description of the financial indexes for an ST-ESCO project is given..

Table 15 and Table 16 show the different economical results with different collector price. It has been supposed two different prices of 500 € and 650 € for m^2 of collector[5], that are the approximate costs for large and medium scale plants.

PBT and IRR are presented while substituting natural gas (the worst case, in general, for its low price and emissions), with the considered price for civil sector.

4 different typology of investment are shown:

- without any external funding;
- considering the value of White Certificates;
- with a 30% funded;
- 30% funded and with White Certificates

[5] it has been considered a value for m^2 of installed collector that considers the complete plant costs

Collectors' cost

500€/m^2

	PBT
without incentives	*14*
financed	*11*
white certificates	*13*
financed + certificates	*10*

IRR

years	*8*	*10*	*15*	*20*
without incentives	-8%	-2%	5%	9%
financed	-1%	4%	10%	13%
white certificates	-6%	0%	7%	10%
financed + certificates	2%	7%	12%	14%

Table 15: financial indexes with a cost of 500€/m^2

650€/m^2

	PBT
without incentives	-
financed	*14*
white certificates	-
financed + certificates	*13*

'-' means a PBT over 14 years

IRR

years	*8*	*10*	*15*	*20*
without incentives	-14%	-8%	1%	5%
financed	-8%	-2%	5%	9%
white certificates	-12%	-6%	2%	6%
financed + certificates	-6%	0%	7%	10%

Table 16: financial indexes with a cost of 650€/m^2

Figure 5 and Figure 6 show the sensitivity of the considered indexes for the substitution of different conventional fuels, under the condition of a plant cost of 500 €/m^2

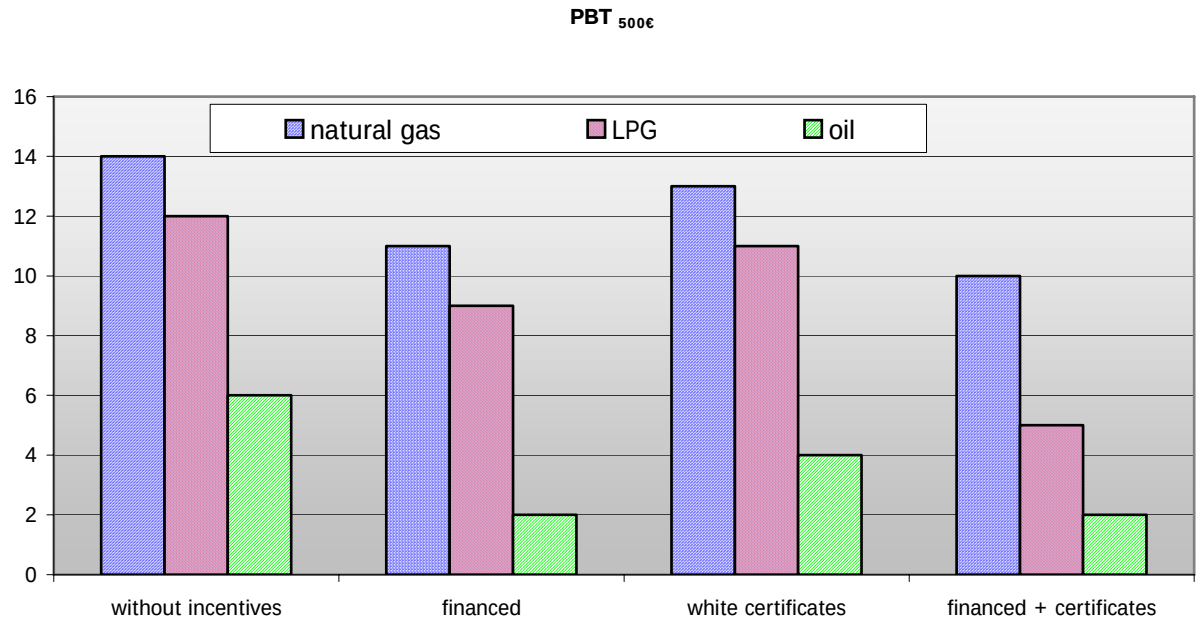


Figure 5: PBT for different fuel substituted

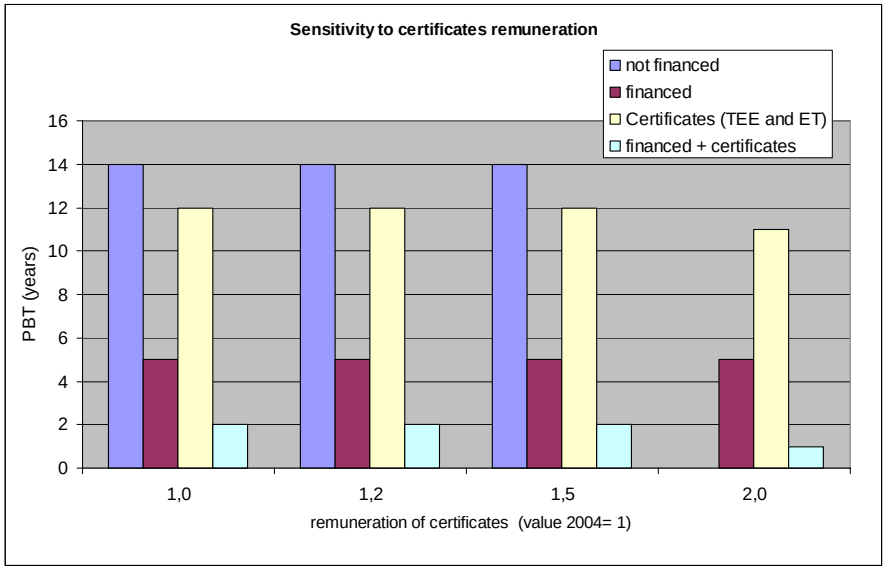
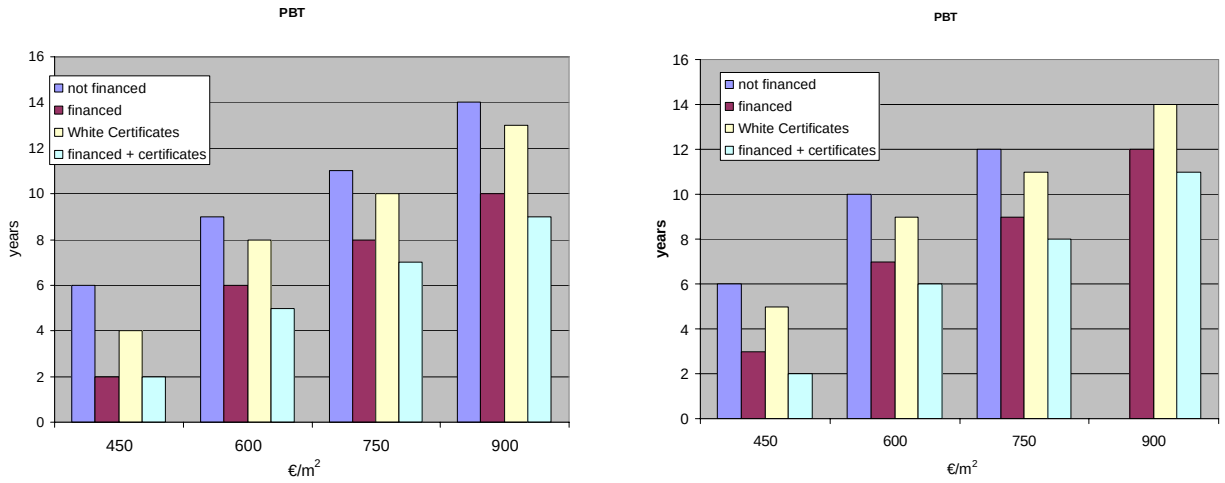


Figure 6: IRR for different substituted fuel

In Figure 7 are presented some simulations done for agricultural sector, to show economic performance of ST plants at the changing of the plant price. The simulations show and compare electricity and oil substitution



electricity *oil*

Figure 7: agriculture – sensitivity of PBT and $IRR_{10years}$ to plant price: substitution of electric energy (left column) and oil (right column)

For industrial sector is presented a simulation to evaluate the sensitivity to certificates (White certificates and Emission Trading) remuneration. As shown in Figure 8, the certifications value is not fundamental in the economic analysis. But it's important to remember that their relevance can grow while looking for external funding to realize a solar thermal project.

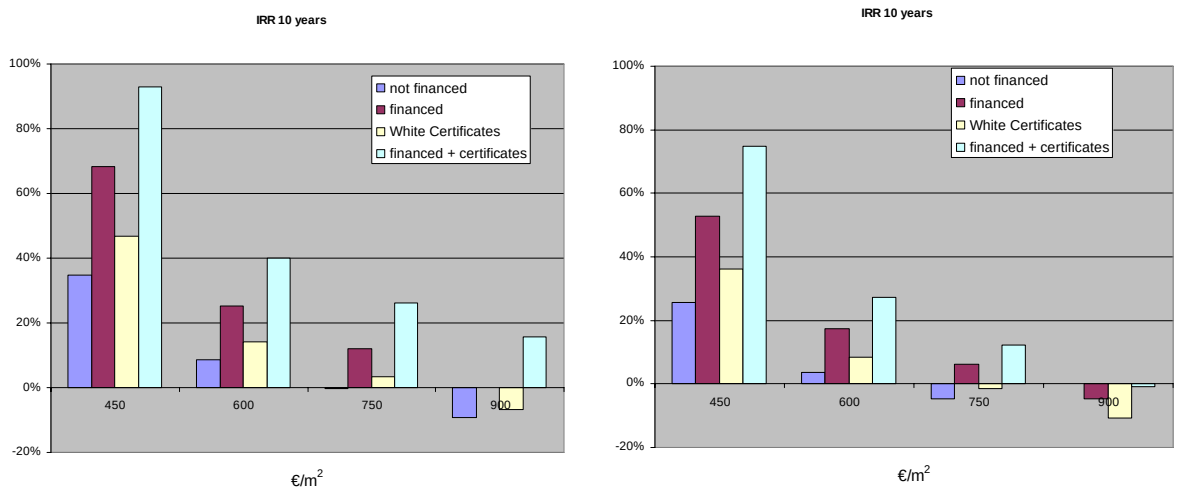


Figure 8: industrial – sensitivity to certificate remuneration

3.3 Conclusions

The simulations just help to give the main parameters in solar thermal market:

- the role of public funding is almost necessary for the development of the solar thermal market, to be competitive with other technologies and reach interesting economic parameter, acceptable also for economic and financial institutions. The 30% value (the usual funding for ST installation in Italy) provides significant reduction in all the financial indexes;
- the price of conventional energy can modify the economic considerations: even if they have just a little range, this can be sufficient in some border cases;
- the substitution of non methane fossil fuels can provide a cost effective interventation; solar thermal applications in building renovation projects can have significant results;
- Collectors' cost is the main parameter for the feasibility of a new installation;
- The money cost rate is fundamental in the ESCO cases, where long contract period are foreseen; the reduction from a first value of 6% to 3.5% (credit facility rate value) can reduce the PBT up to 3 years and increase the IRR of about 1%
- certifications are at the moment not so important in term of economic benefit. Their importance is related to the guarantees requested for a loan, as a minimum guaranteed benefit;

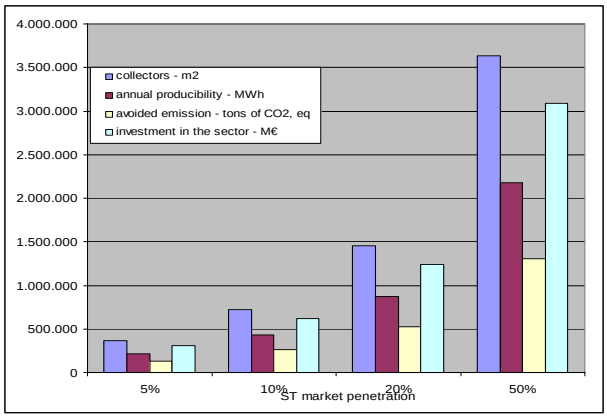
Some simulations were done to show the impact of an increasing "solar factor" in the substitution of conventional fuels. It has been considered the total consumption of the sector, assuming a percentage of substitution with solar thermal plant (solar market penetration).

The results are just to give an idea of the main quantity of the market (m^2 of installed collectors, producibility, avoided emissions and provision of the money related to the market development).

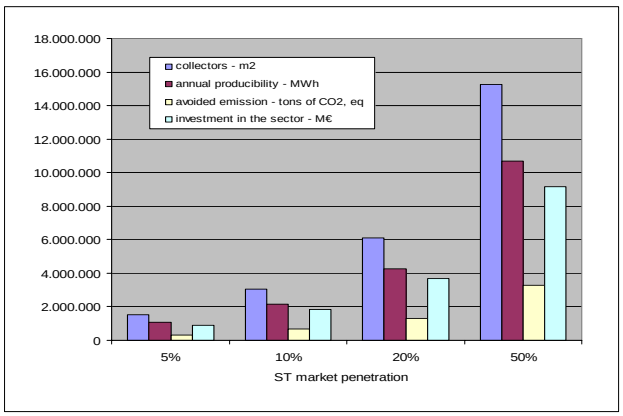
The total potential is really huge; the "ST market penetration" figures show that in any sector the diffusion of solar technologies is ready to open an important "new" energy market sector; the

potential development of solar thermal technologies is really explosive. And so the ST-ESCO potential market too.

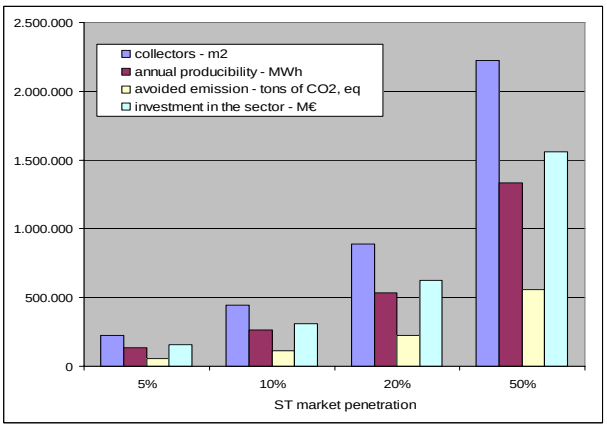
Residential



Tertiary



Agriculture



Industrial

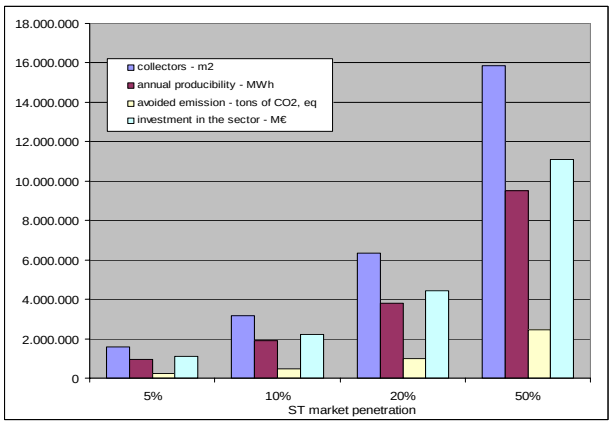


Figure 9: solar thermal potential market rate; main parameter, divided for sector

4 References

AUEN, Relazione annuale, Autorità per l'Energia Elettrica e Gas, 2004

ENEA, "Rapporto Energia Ambiente 2004"

ENEA, Il ricorso al finanziamento tramite terzi, Giampaolo Valentini, 1997

EP-IEA – Energy policies of IEA countries, Italy 2033 review – OECD/IEA 2003

ESTIF 1 - Solar Thermal Markets in Europe - TRENDS AND MARKET STATISTICS 2004. June 2005.

ESTIF 2 - Sun in Action II – A Solar Thermal Strategy for Europe, Vol 2. April 2003.

IEA DSM - IEA DSM, Task X Performance Contracting - Country Report - Italy, 2002

MAP, “Scenario tendenziale dei consumi e del fabbisogno al 2020”, Ministero Attività Produttive (Direzione Generale Energia e Risorse Minerarie), 2005

MICA, “Bollettino petrolifero”, Ministero delle Attività produttive, 2004

POSHIP - The Potential of Solar Heat for Industrial Processes, “Final report”, 2001; EU project of Programme ENERGIE (5th Framework Programme for Energy, Environment and Sustainable Development)

SOLARGE: “Market report for Enlarging Solar Thermal Systems in Multi-Family-houses and Hotels in Italy”, 2006; European co-operation project funded by the European Commission’s Intelligent Energy – Europe programme

Annex 1: ESCO's market – Questionnaire: results summary

The size of the companies is mainly small-medium:about 70% has less then 15 employees, even if there's a great utilization of freelance and occasional collaborations (considering freelancers and employees, the 60% of ESCOs has less than 30 workers);the capital is below 2.500.000 €/ year for the 80% of ESCOs.

As regards their projects' financing, most of them look to TPF (bank financing or equity capital). A consistent percentage of projects is financed (totally or partially) by public contribution. In case of external funding, the guarantee requested by the financing Institute, is represented by the company's budget, followed by the "goodness" of the same project.

Above 50% of projects have been financed through the TPF mechanism and 41% of cases the pawn is in the same project.

Most of them are equity capital based and only a little number of them is mixed public/private capital.

Their customers are mainly Public Administrations (21%), Small and Medium enterprises (21%) and Industry (19%). Still at a low level, but with the higher growth rate, is civil sector (both tertiary and residential).

Also the innovative typology of contracts are quite diffused: and. The typical contract life is 5-7 years in 46% of cases and 8-10 years in 27% of cases.

The typology of contracting falls in the following ones:

- EPC (Energy Performance Contracting) (44% of the total) mainly with shared savings mode;
- Energy Service (41%) and similar ones. In most cases the service is paid according to the amount consumed . In the 42% of cases the service is paid according to the amount consumed; another 32% is covered by a fixed fee.

The peculiar ESCo's features are: consulting, auditing, designing, installation and plant management, as well as energy service.

About the certification market result that above 50% of companies aren't (still now) operating on it; they show interest on it, but often is too expensive the procedure for the certification of projects' results, compared with the related business.

As regards energy production from renewable sources, the main ones are:

Solar Photovoltaic, Solar Thermal, Biomass.

Most of ESCOs have already carried out realizations of solar thermal plants in the field of:

Designing, Installation and Materials' supply,

The users belong to the area of:

- Residential (private), the most important in term of number of installations;

- Public Administration (mostly schools);
- Hotels and Tourist buildings.

The applications are for hot water production and heating, with a small percentage of air conditioning; the plant dimension is under the 30 m^2 for the most of installation.

Among the reasons for which societies don't carry out realizations in the field of solar thermal we can mention the following considerations:

- Inadequate pay back time;
- Too high initial investment;
- The lack of adequate designing tools.

Annex 2: Market scenarios for solar thermal plants

Methodology

Hypotheses:

- A part for residential sector, energy consumption (total and divided for source) is considered constant at present value (2002). It has been considered the statistical data for low and medium temperature heating production; has been taken a solar thermal market fraction with a base level of 10%;
- energy prices are considered starting from the 2004 value, and modified only through a fixed annual growth rate;
- if not indicated, the plants have been taken with a cost of 700 €/m^2 (total plant cost referred to m^2 of installed collectors) and an annual producibility of 600 kWh/m^2/yr;
- for the obtaining of certificates are not considered the minimum quantity of toe saved (for white certificates) or tons of avoided $CO_{2, eq}$ (for Emission Trading)

General reference data:

- Money cost 6% per year
- Inflation rate 2% per year
- Energy price growth rate 4% per year
- Plant managing cost 2.5% of its value
- Installment period 7 years
- Life of plant 20 years
- Subsidies 30% of the total cost
- White Certificate value 100 €/toe
- Emission Trading value 20 €/ton$CO_{2, eq}$

Indicators:

- Technological parameters:
    - Installable collectors (kW and m^2)
    - Solar Thermal producibility (kWh)
    - Avoided emission (tons of $CO_{2, eq}$)
- Economic parameter:
    - PBT - Pay Back Time of the investment;
    - IRR - Internal Rate Return, considered at 8, 10, 15 and 20 years.

Regarding **residential sector**, for the evaluation of new buildings potential ST-ESCOs applications the methodology has been the following:

Starting from the data of new suitable multi family buildings (with more then 9 flats), it has been estimated the total number of flats (minimum value and average value); the total surface has taken from the average value taken by ISTAT and some consideration on heat consumption have been done from the 192 law (energy consumption reduction on residential building). Then a solar fraction has been supposed.

Data:

Flats for building

class	min value	avg value
9 - 15	9	12
> 15	15	20

average surface 93 m^2/flat

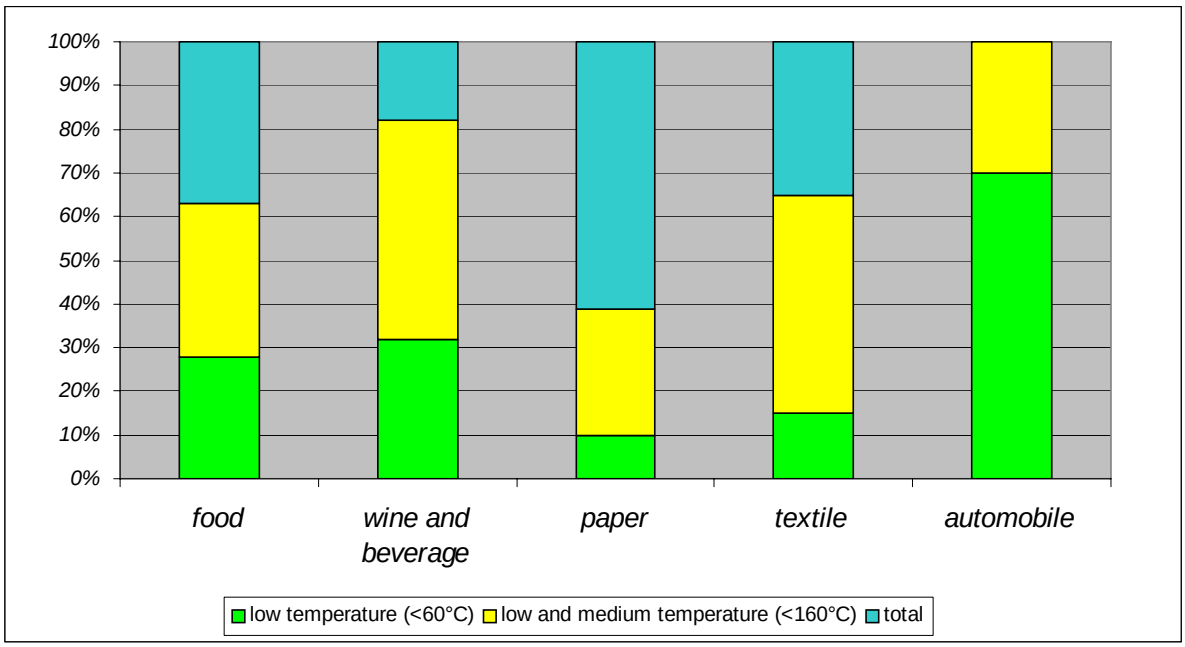
average consumption: 45 kWh/m^2/y for space heating

20 kWh/m^2/y for DHW

solar fraction: 25% for combi plant

50% for the sole DHW production

Regarding the **industrial sector**, it has been developed the only sectors considered in POSHIP project. So the base data has been created starting from the value of conventional fuels, filtered through the consideration presented below. The "ST market penetration index" has been applied to this value.



4.1 Other data

Avoided emissions

Combustible substituted	***Kg $CO_{2,\,eq}$ for kWh produced***	***m^2 of collector for avoided ton $CO_{2,\,eq}$ / year***
Electricity (national mix)	*0.6*	*2.8*
Natural gas	*0.2*	*8.3*
LPG	*0.25*	*6.7*
Oil	*0.3*	*5.6*
Combustible oil	*0.5*	*5.6*
Carbon	*0.5*	*3.3*

Table 17: conversion factor for avoided emission

Energy prices for sector:

Energy cost (€/kWh)	***Residential***	***Tertiary***	***Agricultural***	***Industrial***
Electricity	*0,15*	*0,15*	*0,15*	*0,10*
Natural gas	*0,06*	*0,06*	*0,06*	*0, 07*
LPG	*0,06*	*0,06*	*0,06*	*0,04*
Oil	*0,09*	*0,09*	*0,09*	*0,04*
Combustible oil	*0,03*	*0,03*	*0,03*	*0,04*

Table 18: energy prices, divided for sector;

White certificates:

form for standard evaluation of saved energy for solar thermal collectors

AEEG: technical form n.8

"utilization of solar collector for DHW production"

[10^{-3} toe/m^2 coll]

primary energy substituted		plan collector		vacuum collector	
		electricity	gas, oil	electricity	gas, oil
climatic area	**1**	122	61	153	76
	2	165	82	192	96
	3	181	90	209	104
	4	228	113	249	124
	5	247	123	269	134
	AVG	188.6	93.8	214.4	106.8

Table 19: AEEG, technical form n.8