EBHE
ΕΝΩΣΗ ΒΙΟΜΗΧΑΝΙΩΝ ΗΛΙΑΚΗΣ ΕΝΕΡΓΕΙΑΣ

The Greek Solar Thermal Market

Overview of the market situation

Greece is one of the most successful countries worldwide in the use of solar thermal energy. For many years, the number of installed parks of solar collectors per capita has been the highest within Europe.

The solar thermal market started 30 years ago. At that time, almost all Greek households were using electric heaters; thus, the rising price of electricity has helped the market to develop. The electric water heater is still the main competitor to the solar water heater.

The main solar thermal product was then, and still is, the thermosiphonic water heater. Many companies have been started in these years. The advertising campaigns launched by larger firms helped a lot in the initial phase. The Greek Solar Industry Association (EBHE) was created in 1978.

The market was steadily rising, as in many countries, in part due to the oil crisis. In 1984–86, a large advertising campaign supported by the Greek government and the implementation of VAT by the end of 1986, boosted the sales up to 218,000 m^2. There were about 300 'manufacturers' of solar systems at this time. Nearly all the systems were produced locally, except for some which were imported mainly from Israel. Low interest loans and tax credits were available at this time.

Then the market consolidated; the efficiency and reliability of the products were improved, and the number of manufacturers decreased. Standards were introduced on the national level by the end of the eighties. The solar systems' laboratory of 'DEMOKRITOS' and the Centre for Renewable Energy Sources (CRES) have since then been cooperating closely with the manufacturers and have contributed decisively to this direction.

Since 1993, the domestic market has fluctuated between 150,000–200,000 m^2 of collectors, depending on the new building production, electricity prices, incentives etc.

Many solar thermal systems are also installed in hotels and in industries, athletic centres and greenhouses.

The main reasons for the success in the solar thermal utilisation in Greece are:

- The conventional source of water heating is electricity, with higher costs than fuel oil or gas, leading to shorter payback periods for solar systems.
- Most houses have a flat roof, enabling the easy installation of an inexpensive thermosiphonic water heater.
- Favourable climatic conditions.
- State support during the start-up phase of solar thermal.
- Involvement of dedicated individuals at the early stages of solar thermal.

Having reached a certain level of experience and quality and facing difficulties in the home market, some of the manufacturers turned to product development, assisted by

EU-supported R&D projects, and to exports. The success of the pioneers has motivated other companies as well. By 2001, more than 40% of the solar collector production of EBHE members was exported, starting from very low percentage (less than 5%) in 1991.

Several demonstration projects have been carried out. The most well known is 'Solar Village' close to Athens, built in 1987 and reliably operating since then, with 435 dwellings and approximately 1,700 inhabitants, featuring several solar systems for hot water production and space heating, cogeneration, heat pumps etc. There are also several demonstration projects for process heating in the diary, wine, textile dyeing/finishing, rice drying and tannery industry. Some of them (Achaia Clauss Winery, MEVGAL diary, etc) were installed on a guaranteed performance base. In recent years a big demonstration project for solar cooling was erected in the Sarantis SA cosmetic industrial complex close to Athens.

The main competitor of the solar water heater is, as mentioned above, the electric heater. In the last decade, the electricity cost decreased in real terms by 28%. Additionally, the VAT for electrical energy and gas is set to 8%, whereas the VAT for solar systems is 18%. This has lead to a decisive loss of competitiveness for solar water heaters.

Currently there is no subsidy for solar systems in the domestic sector.

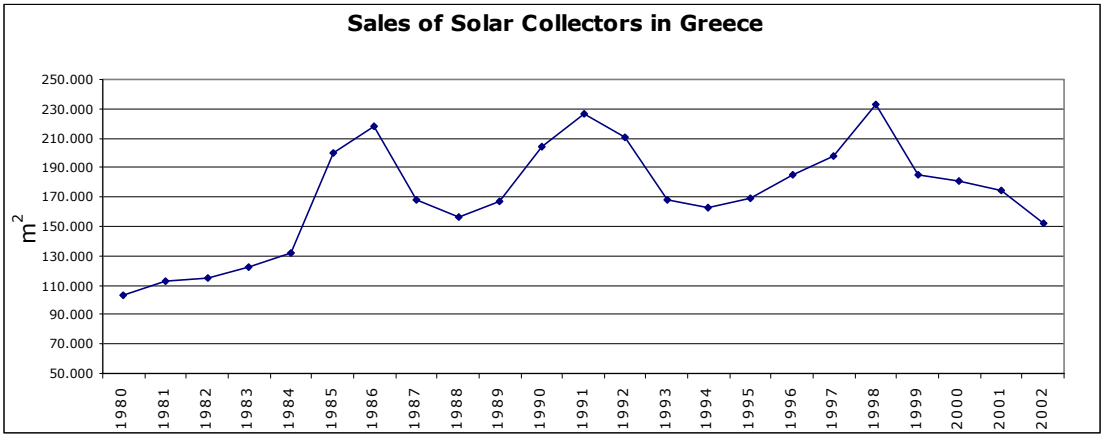
The low price of fuel oil, combined with a lack of subsidies, make solar systems in the industrial sector, solar space heating and cooling, etc., not financially attractive. Hence no new sectors are likely to be added in the near future to the solar thermal market, and solar water heating will probably remain the main solar thermal application in the next years.

Due to the strong competition, the prices for solar systems are low. The profit margins of the manufacturers are not high enough to finance a marketing campaign and marketing budgets are low. There has been no important 'technical innovation' or new marketing method introduced. Solar assisted space heating is not included in any price list of any company.

On the other hand, solar water heaters are standard equipment. The consumer is very well acquainted with the product and in many cases (e.g. replacement of an old heater) does buy a solar water heater almost automatically. Therefore the market in Greece is not expected to suffer either a meltdown or to achieve a breakthrough to increased volumes in the near feature.

The fact is that even in Greece, in the absence of subsidies, solar energy is conditionally feasible only for domestic water heating. Without funding from national or EU sources, the spread of solar thermal systems cannot increase significantly.

Solar thermal installations and energy production



Solar collector production and sales in m^2				
	National Production	**Exports**	**Imports**	**Total Home Market**
1982				115,000
1983				122,000
1984				132,000
1985				200,000
1986				218,000
1987				168,000
1988				156,000
1989				167,500
1990				204,000
1991				227,000
1992	212,000		5,000	211,000
1993	199,000	6,000	4,000	168,000
1994	216,000	35,000	4,000	163,000
1995	240,000	57,000	4,000	169,000
1996	260,000	75,000	5,000	185,000
1997	279,300	80,000	3,000	197,300
1998	321,300	85,000	2,100	233,400
1999	280,250	90,000	4,750	185,000
2000	283,600	100,000	7,400	181,000
2001	287,550	110,000	7,450	175,000
2002	256,500	120,000	5,500	152,000

Source: "Collection of statistical data on Solar Energy Applications in Greece", Eurostat contract No 2000 45300002, CRES 2001; EBHE estimations;

Estimated solar park in operation at the end of 2001

Total collector area in m^2: 2,790,200 = 264 m^2/1,000 inhabitants

Estimated annual solar thermal energy production in 2001

Total 2,790,200 x 388 kWh/m^2·year = 1,082,598 MWh

CO_2 emissions avoided in 2001

Total 1,082,598 MWh/a x 1.1 tonnes/MWh = 1,190,857 t

Product types and solar thermal applications

Product types

99% of the installed collector area is for thermosiphonic type water heaters, mainly closed loop systems. The closed loop systems use antifreeze liquid to avoid the freezing of the collector loop. The storage tank can be vertical or horizontal and is mounted higher than the collectors. The average size of thermosiphonic type systems is 2.4 m^2 collector area and 150 lt storage tank. The range of the most common used systems is between 120 lt– 220 lt with 1.8–4 m^2 collector area. All the systems are equipped with electric back-up heaters. 30% of them are equipped with an additional heat exchanger connected with the fuel or gas heating system. The solar fraction is usually over 75%.

150,000 m^2 of collectors are installed in hotels, including large collective systems, but there are also thermosiphonic water heaters in studios, apartments, and smaller pensions. There are a large variety of other applications i.e. in industry, commercial buildings, hospitals, athletic centres and greenhouses.

There are some systems with evacuated tube collectors but their market share is insignificant.

Applications

- Domestic hot water production (~99% of installed collector area).
- Mainly thermosiphonic water heaters, including hotel studios, small commercial and industrial consumers.
- Large collective solar systems (~1% of installed collector area) are installed mainly in hotels for hot water production.
- Space heating, district heating, air conditioning and industrial process heating combined have less than 1% of the installed collector area.

Employment

The total number of people employed in the solar branch is approximately 3,000. Directly employed in the manufacturing sector (production, sales and marketing, development, financial services, etc) are approximately 1,200 people. The supply of material and services to the manufacturers is estimated to account for approximately 200 full time jobs. Retail sales, planning, installation and maintenance account for approximately 1,500 full time jobs. Research, testing, and consulting account for approximately 100 full time jobs.

STATE OF PRODUCTION

Product technology and production methods

Product technology description

Collectors (usual sizes)	1.5–8 m^2
Absorber material	Steel or stainless steel rollbond Aluminium or copper bonded on copper or galvanised steel tubes Copper tubes expanded in aluminium extruded profiles Copper bonded on copper tubes Copper welded or soldered on copper tubes
Surface treatment	Black paint Selective paint Selective treatment
Insulation	Many variations starting with glaswool 30mm to combined hard PU-CFC free + rockwool totally 70 mm
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
Storage tank	Materials: Steel with enamel or epoxy or other 'plastic' inside protection Stainless steel Galvanised steel Copper Insulation: 40–70 mm PU
Cover	Aluminium, stainless steel, steel painted or galvanised, ABS

It is clear that the efficiency of collectors and systems varies. The test results under the ISO standard for system efficiency are showing output from 350–800 KWh/m^2.a.
Of course in practice the efficiency is heavily dependent on the user's consumption profile.

High efficiency collectors with selective surface on copper, welded on copper tubes, using tempered glass are increasing their market share.

There are also various types of Integral Collector Storage (ICS) and compact systems as well as a compact Heat Pipe system.

Production methods and capacity

There is a large variety of manufacturers from 'back yard manufacturers' to industrial ones. The back yard manufacturers assemble components they produce themselves and components bought from other manufacturers. They may buy absorbers and complete the collectors themselves, buy the tank ready made or only the inner tank and add the outer casing plus insulation etc.

Manufacturing is usually to some degree automated, but both manual and automated manufacturing exist.

Productivity can range from rather low, up to more than 1.200 m^2 per person per year.

The production methods, machinery and general infrastructure, are becoming more industrial. There are clearly manufacturing over-capacities; the capacity utilisation is less than 50%, the current production being 250,000 m^2 and 55,000 solar tanks of 120–220 lt.

Almost all major manufacturers follow a quality assurance system, certified according to ISO 9000. The product standards are the new CEN standards for collectors and packaged systems.

Breakdown of solar systems costs

Solar Systems Costs for Typically Sized Systems		
	Individual	**Project (large scale)**
Total costs (excl. VAT)	250 €/m^2	200 €/m^2
VAT (18%)	45 €/m^2	36 €/m^2
Total cost (incl. VAT)	295 €/m^2	236 €/m^2
Typical size of system	2.4 m^2	100 m^2

Percentage cost breakdown

Average thermosiphonic type DHWS, VAT 18% not included, calculations based on retail price.

Materials	33%
Labour	10%
Promotion + general expenses	43%
Installation (labour and materials)	14%

Typical solar domestic hot water system

The typical DHW system is the thermosiphonic solar water heater

Collector area (m^2)	2.4
Hot water storage (litres)	150
Total installed cost (VAT incl.)	708 €
Eventual subsidies	None

Typical consumer motivation

The motivations to buy a solar system are:

- Savings (expected payback period 5-10 years).
- Better comfort (in the conventional case of the electrically heated hot water, the heater is turned on just before consumption is going to take place in order to save energy losses, thus requiring a waiting time for the water to be heated up).
- To buy a solar system in Greece is as easy as to buy an electric heater. As most roofs are flat, the installation is easy, too.

Conventional water heating and energy prices

Conventional Energy Prices		
Date: 2000	**Housing VAT incl.**	**Collective VAT incl.**
Electricity – normal	0.076 €/KWh	0.084 €/KWh
Electricity – low rate	0.042 €/KWh	
Fuel – Oil	0.035 €/KWh	0.025 €/KWh
Natural gas	0.026 €/KWh	0.022 €/KWh

Standards and codes of practice

There is no legal obligation for solar collector testing. Still, for the solar water heaters the tank has to be tested to get the CE marking.

Major manufacturers follow a quality assurance system, certified according to ISO 9000. The product standards in use are the new CEN standards for collectors and factory-made systems.

- 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 ISO 9488: Solar Energy – Vocabulary
- ENV 12977-1: Thermal solar systems and components – Custom Built Systems – Part 1: General Requirements
- ENV 12977-2: Thermal solar systems and components – Custom Built Systems – Part 2: Test methods
- ENV 12977-3: Thermal solar systems and components – Custom Built Systems – Part 3: Performance Characterization of Stores for Solar Heating Systems

Testing is carried out by the Demokritos Centre. Certification bodies include several companies like ELOT, TÜV Southern Germany, TÜV RW, TÜV Austria, Lloyds, etc.

Level of R&D

There is basic research in the universities as well as R&D projects involving manufacturers and institutes or universities. Funding is available from public or EU institutions. Demokritos Centre and the Centre for Renewable Energy Sources are conducting applied research.

The R&D activities aim to develop a new range of systems to meet specific needs and targets (i.e. modular central systems, ICS, compact low visual impact systems, systems integrated in buildings' envelop, desalination, heating and cooling of buildings, natural gas – back up systems). A significant part of the development efforts of the firms in the field is oriented towards collectors and systems aiming at various international markets.

The performance and reliability of the products has improved significantly in the last few years. A lot of efforts aim at reducing the system and collector cost by the investigation of new configurations, production methods and components' development.

Longer term R&D is directed toward cooling, cogeneration of heat and power, or H2 and heat, thermal storage media, ceramic medium and high temperature solar collectors.

STATE OF MARKETING

Distribution and marketing methods

Domestic solar water heaters are distributed mainly through the HVAC retailers or through wholesalers. They are regarded as standard products like fuel boilers, burners, heating elements etc.

The customer can buy the system through such a retailer, an installer or directly from the manufacturer. Many firms are using parallel all-the-above selling methods. Some of the larger firms are co-operating with distributors on an exclusive base. This means that the distributor sells only equipment of this manufacturer (solar and heating usually).

The major manufacturers are active almost everywhere in Greece. A common practice in Greece is the selling of solar systems directly to the users in exhibitions. More than 10 large building material exhibitions and several local exhibitions take place each year. However, the exhibitions are not as effective as in the past.

The marketing of the product is based mainly on quality and price. The technology and materials and also the reputation of the company are promoted. Networks of distributor companies often promote their own brand name.

All the common promotion methods are used. The most important ones for the manufacturers are professional fairs (2 annually), advertising in specialist journals and contact to retailers through salesmen. For the final customer advertisement campaigns in radio, newspapers and magazines, and tables in athletic centres are a common practice.

The yellow pages are full of solar systems advertisements. The budget for solar systems advertising has been minimised in the last years due to falling retail prices. In the past EBHE organised some collective campaigns. In 1984 and 1986 a large TV promotion campaign was undertaken by EBHE with financial support from the government. This contributed to a sales increase.

A short TV campaign co-financed by the EU and the manufacturers was presented in October 1994. The results were positive, although the general presentation and the short period of releasing were not market-oriented. A co-operation of EBHE and PPC (Public Power Corporation – electricity utility) to promote DHWS through PPC's outlets started in

November 1994. Posters and leaflets were distributed through PPC's service offices and a small informative leaflet was distributed through the bills.

The systems are covered usually with warranty of up to 5 years. The reason is to guaranty the system until it is paid back. There are companies offering longer warranty period as promotion tool (10–30 years). The common maintenance of a system is limited to the electric heating element and anode (cathodic protection for the tank) replacement. According to the manufacturers, the systems retrofit market is less than 5%.

The large systems are mostly installed by the manufacturers or through large distributors who have the capability to cover the engineering needs of the project. For the most of them, grants from the European Commission were applied. The only subsidy system left is based on calls for projects. This is not providing a steady base to develop this market, resulting in a more opportunistic market.

EBHE has organised, also within EU projects, workshops and contacts with various professional associations like Hoteliers, Dairy and Wine industry, etc.

The decreasing domestic market has pushed the manufacturers to include in their product range other products addressing to the same distribution net (i.e. heating and cooling equipment) or to co-operate with distributors.

Some 30% of houses in Greece have a solar system installed already. The figure is very low compared with the potential, bearing in mind that in similar cases (Cyprus, Israel) the percentage is over 90%.

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

Most of the collective systems (150,000 m^2) were subsidised by 50%. These systems are installed mainly in hotels or industries. The low oil price results in payback periods longer than 5 years and makes the solar system less attractive for the investor.

Guaranteed solar results contracts have been used up to now only on a pilot base.

Incentives and financing methods

At present no financial incentive scheme exists for domestic solar systems.

For DHWS incentives were established in the early eighties. These were based on a soft loan (available only for solar systems) and tax credit. A constant amount, representing a significant part of the system cost, could be deducted from income tax. Then for some years tax credit was not available.

In the last few years, 75% of the solar system value could be deducted from taxable income. Unfortunately this incentive was abandoned as of 2003. Soft loans are not available any more.

For industrial and commercial applications only subsidies are at certain times available to support investments on solar systems with grants ranging from 30% to 40%. These subsidies are based on calls and are not available on a constant basis. The result is that when a customer decides or is convinced to buy a solar installation, usually no funding is available.

Third party financing has been used only on a pilot base.

FUTURE PROSPECTS

National energy policy

The production of energy was and is based on traditional fuels: lignite, oil and electricity generation by hydro. The share of renewable energies (including firewood) is estimated to be 10% of the total energy production, the share of solar thermal energy alone 1.3% of the total energy production.

There are two main priorities in the energy policy in Greece: first the completion of the basic infrastructure for natural gas and the gradual penetration of the market through it, and second the deregulation of the electricity and natural gas market, which is expected to be completed by 2006. In recent years, wind energy and small hydro received strong state support, and by the end of 2003 the installed wind energy capacity reached 374 MW.

Still, since solar energy substitutes for electricity in domestic hot water production, it contributes a lot to the reduction of electricity consumption; it is estimated that 1,150 GWh of electricity are saved annually, corresponding to 8.1% of the electricity consumed by the households [3].

The solar water heaters are also contributing a lot to the security of supply of electricity.

Due to the extensive use of electric air conditioners, the electricity network is working at close to breakdown during several days of the summer. This situation is more critical on those islands whose electricity network is not connected to the mainland network.

Objectives for the solar industry/market

The objective should be not only to increase the use of DHWS for single families but also to disseminate the use of solar systems to other potential users, i.e. industry, commercial and public buildings. Solar space heating is also an objective to be pursued in the next years.

The fact is that even in Greece, in the absence of subsidies, solar energy is conditionally feasible only for domestic water heating. Since no support is expected the prospects are that the situation will remain more or less constant.

Strategy to overcome the barriers to market development

1. **Institutional**

Use of solar energy should become obligatory for domestic water heating.

To achieve this, national and EU policy makers should be lobbied to pass regulations requiring the use of solar DHW systems

2. **Economic**

The main competitor to the solar water heater (main solar product) is the electric heater. The government practically subsidises the electricity price. Additionally the VAT for electricity is 8%, whereas VAT for solar systems is 18%. The solar thermal industry should lobby national politicians to sufficiently level the playing field: solar thermal must have the chance to compete on equal terms with electric water heaters.

Currently there are no financial incentive schemes for solar systems. It has been shown that public support was important in initially developing the solar DHW market.

Especially in the commercial sector, and for applications like solar assisted cooling, public support will be essential in creating a sustainable market.

3. **Cultural**

The environmental consciousness of the general public needs to be awakened.

Only then will national and EU policy-makers fully support renewable energy sources, e.g. through financial incentive programs. This environmental consciousness can be achieved by campaigns in cooperation e.g. with environmental NGOs.

Concluding remarks

Under the current conditions the solar market in Greece has reached saturation. The fact is that even in Greece, in the absence of financial incentive schemes, solar energy is conditionally feasible only for domestic water heating.

Without funding from national or EU sources the market penetration of solar thermal systems will not increase significantly.

The solar thermal community needs to make public the advantages of solar energy, the fact that funding is required to assist the spread of solar thermal but that funding requirements are moderate. Political pressure in this direction should be exercised, both on a national and EU level.

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