1. Introduction

Greece is located in the south-eastern Europe (located between the 34° and 42° parallel N, with a meridional extent from 19° to 28° E), on the Southern end of the Balkan Peninsula. It is bordered with Albania, the former Yugoslav Republic of Macedonia and Bulgaria on the north; to the west by the Ionian sea; to the south by the Mediterranean sea and to the east by the Aegean sea.

The country consists of a large mainland at the southern end of the Balkans; the Peloponnesus peninsula and numerous islands (around 3,000). About 80% of Greece consists of mountains and hills, thus making Greece one of the most mountainous countries of Europe.

Greece has a total area of 131,957 sq. km and the population rises up to 11,170,957 (estimate 2007), with a growth rate of 0.18%. Athens is the capital and the largest city, with a population of 3,361,806. Almost two thirds of the population live in urban areas.

Climate

The climate in Greece is typical of the Mediterranean climate: mild and rainy winters, relatively warm and dry summers and, generally, extended periods of sunshine throughout most of the year. A great variety of climate subtypes, always within the Mediterranean climate frame, are encountered in several regions of Greece. This is due to the influence of topography (great mountain chains along the central part and other mountainous bodies) on the air masses coming from the moisture sources of the central Mediterranean Sea. Thus the weather in Greece varies from the dry climate of Attiki (Athens' greater area) and East Greece in general, to the wet climate of Northern and Western Greece.

In climatological terms, the year can be broadly subdivided into two main seasons: The cold and rainy period lasting from mid-October until the end of March, and the warm and dry season lasting from April until September. During the first period the coldest months are January and February, with, a mean minimum temperature ranging, on average, between 5 -10 degrees Celsius near the coasts and 0 – 5 Celsius over the mainland, with lower values (generally below freezing) over the northern part of the country. The winter is milder in the Aegean and Ionian Islands compared to Northern and Eastern mainland Greece. The warmest period occurs during the last ten days of July and the first ten days of August, when the mean maximum temperature lies between 29.0 and 35.0 degrees Celsius.

Economy

Greece has a mixed capitalistic economy with a large public accounting for about 40% of GDP and with per capita GDP at least 75% of the leading euro-zone economies. The greek economy has improved in recent years due to the tight policy before and after EU's single currency. The economic improvement from 1990 to 2000 is a budget deficit below 1% of GDP and an inflation which fell from 20% to 3.1%. Nevertheless, the reconstruction of the economy and the reduction of unemployment (11.3%) are the major challenges of the country.

The economy is mainly based on agriculture with 20 % of the workforce employed in this sector. 59 % of the workforce is employed in the sector of services and the 21 % in the sector of industry and construction. Even if Greece is an agricultural country, the agricultural contribution to the economy is only of 15 %. The industry which contributes the most to the economy is the tourism industry and the shipping.

GDP official exchange rate	**: 223.8 billion $**	**(2006 est.)**
GDP growth rate	**: 4.2%**	**(2006 est.)**
GDP per capita	**: 24,000 $**	**(2006 est.)**
Inflation rate	**: 3.3%**	**(2006 est.)**

2. Building and energy data

Building stock by type of use

Total number of buildings (exclusive use)	*Domestic buildings*	*Churches - Monasteries*	*Hotels*	*Industrial buildings - laboratories*	*School buildings*	*Commercial buildings and offices*	*Car parks*	*Hospitals*	*Other*	Mixed use	**Total (exclusive use and mixed use)**
3.577.355	*2.755.570*	*43.463*	*22.830*	*31.422*	*16.804*	*111.097*	*510*	*1.961*	*593.698*	413.615	**3.990.970**

Ref: National Statistical Service, Total number of buildings per use in Greece (inventory 2000)

Additional comments:

- Residential buildings represent about 72-77% of the total building stock in Greece (2.5 million residential buildings in 1990). Moreover, 30% of the residential building stock concerns urban and 18 % semi-urban areas.

Age of building stock

Total number of buildings	*Before 1919*	*1919-1945*	*1945-1960*	*1961-1970*	*1971-1980*	*1981-1985*	*1986-1990*	*1991-1995*	*1996-*	Under construction	Not registered
3.990.970	*199.510*	*406.633*	*665.315*	*761.182*	*737.575*	*404.303*	*297.348*	*241.615*	*191.739*	57.430	25.320

Ref: National Statistical Service, Total number of buildings per use in Greece (inventory 2000)

Construction rate

The most intense construction work was in the 1960s when the construction work address to a percentage of 19% of the total building stock. At the period 2000-2004,

there is an increase in construction permits of a percentage of 18%. From the registered permits, a percentage of 50-54% corresponds to new building works and extensions to 13 – 17%.

Renovation rate

Data on building renovation is available through the National Statistical Service of Greece. However, only a part of actual renovation occurring is recorded and data is not available on the type of renovation actions.

The recorded percentage of renovation projects (to the overall amount of permits for new buildings as well as renovations) was 4,5%, 4,7%, and 5,5% for the years 1997, 1998, and 1999 respectively. However, a new construction market has started growing during the last years in Greece. An increasing number of construction enterprises focus their activities on building renovation projects. Most of these renovation projects are not recorded, as permit processes are costly and time consuming. However, due to building stock ageing and refurbishment needs, this particular market segment is growing fast. For the period 2000-2004, from the registered permits, a percentage of 8 – 10% corresponds to renovation projects.

Common building practices and systems used

Current common building practice is based on reinforced concrete structure with brick walls. Since 1980, exterior building elements are insulated, beams and columns are insulated externally, exterior walls are made of double brick construction with insulation in between; roofs are either flat with insulation placed above concrete slab or pitched with tiles placed above a wooden or concrete structure with internal insulation. Old buildings (built before 1980) are uninsulated and represent approximately 80% of the building stock.

Heating systems are either central or non central, using mainly fuel oil.

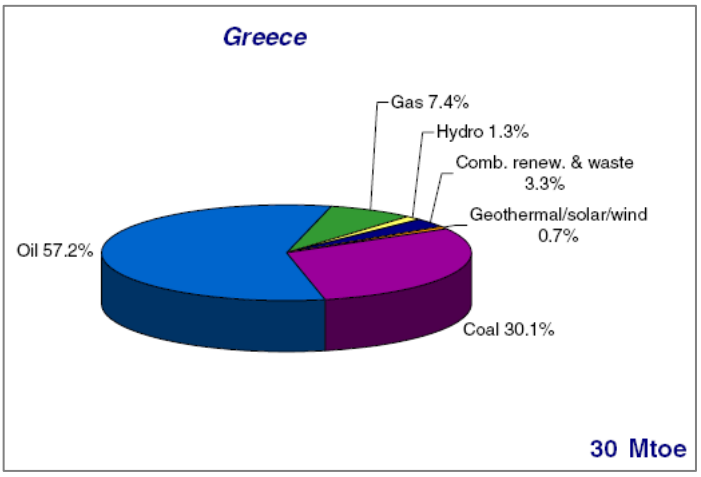
In buildings constructed before 1990, central heating systems based on diesel fired boilers are being used in the vast majority of buildings. Due to low taxation on diesel used for heating purposes, this type of heating is economically very competitive.

Buildings constructed after 1990 are using diesel or natural gas fired boilers and central cooling systems.

Cooling is done by RAC units, which are being installed at ever increasing rates. Very few older buildings utilize water cooled central systems. In building of the tertiary sector heat pumps (air to water or VRV systems) are also used for cooling. These buildings do not employ boilers, in order to avoid the extra complication of two different systems.

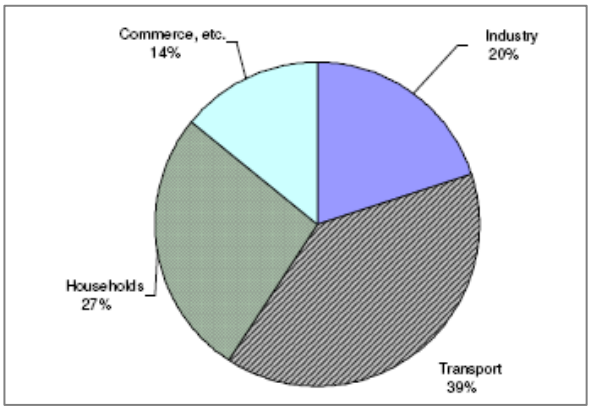
Statistical data on energy consumption

2004 Share of Total Primary Energy Supply



Final energy consumption has increased by 39% since 1990. All sectors, but especially households and commerce, have followed similar growth rates. Transport is the most energy-consuming sector (above EU-27 average of 31%), while households and industry exhibit a total share of 47% in final energy consumption. Oil dominates in terms of types of energy consumed, followed by electricity.

2004 Final Energy Consumption by Sector



Regarding the domestic and tertiary sector, the improving standards of living resulted in continuously increasing levels of energy consumption. Energy demand for cooling, lighting and other office equipment in the tertiary sector is also increasing.

Energy consumption by end use

Domestic sector

	2000	2001	2002	2003	2004
Electricity consumption					
Mtoe	1,222	1,25	1,29316	1,414	1,449
Final consumption					
Mtoe	4,50597	4,65961	4,89224	5,459	5,361
Electricity consumption for space heating					
Mtoe	0,202341	0,207169	0,220395	0,24038	0,22889
Final consumption for space heating					
Mtoe	3,188419	3,301778	3,502341	3,941595	3,829323
Electricity consumption for water heating					
Mtoe	0,101989	0,104423	0,097135	0,10605	0,112547
Final consumption for water heating					
Mtoe	0,223737	0,230714	0,22577	0,244118	0,22827

Tertiary sector

	2000	2001	2002	2003	2004
Final consumption of the tertiary sector					
Mtoe	1,3069	1,4656	1,540411	1,657	1,769
Electricity consumption of the tertiary sector					
Mtoe	1,054	1,1378	1,206483	1,288	1,363

Other: n.a.

(Ref: D-base ODYSEE, Energy Efficiency Indicators, 2006)

Related institutes at local and national level

Ministry of Development–General Secretariat for Energy and Technology: The State body responsible for the formulation of energy policies regarding energy conservation and renewable energies, as well for financing energy applications within various European or National programmes (http://www.ypan.gr/).

Ministry of Environment, planning and Public Works: the State body responsible for the development of legislation, regulations and financing mechanisms in the building sector (http://www.minenv.gr/).

Centre for Renewable Energy Sources-CRES: the National Energy Organisation, provides full support to the State and carries out European Programmes and projects on RES and RUE applied research and promotion as well as Programmes and projects for the State (or other public or private bodies) (http://www.cres.gr/).

Regulatory Authority for Energy: the Independent Administrative Authority operating as the highest advisory body in the field of energy investments and permit issuing (http://www.rae.gr/).

3. Overview of supporting policies, targets, support mechanisms and the role of the main players

Building permit procedures for private and public buildings

Building permits are issued by the Local Planning Departments which operate under the auspices of each Prefecture. A building file containing a complete package of the architectural and structural drawings as well as the studies for thermal insulation and electrical-mechanical systems, is submitted to the Planning Department of the area.

The compliance with the building Regulations is controlled and the building permit is issued. A final control, in the construction phase, is conducted by the Local Planning Department in order to provide the required certificates for the connection of the building to the electricity grid.

Existing legislative framework and financial instruments, promoting solar energy technologies in the building sector, at national level

Technical regulations for the building sector are specified in the 'General Building Code', which defines maximum allowed building factors, site coverage factors and building volume coefficients, in relation to the size of plots and by specific area (for building permits), both for new buildings and for extensions to existing structures.

The 'Regulation for Thermal Insulation' imposed in 1979, sets limitations to heat losses (by setting limits to k values) of the building envelope, varying by climate zone and F/V ratios. By amendment of the General Building Code, since 2000, incentives are provided for the application of passive solar systems onto the building shell. Such incentives foresee exclusion of the area of the energy systems within the building factors and volume coefficients.

Moreover, in the General Construction Code (1985), an exception was provided to the limitations posed with respect to the maximum allowable height of buildings, in case a solar water-heating installation was included.

In 1984-1986 the Hellenic State supported a successful advertising campaign. This campaign, combined with the introduction of the VAT process in the Hellenic taxation system (due to the consumers' expectations this change created a major increase in the durable product market), by the end of 1986 boosted the annual sales of glazed solar collectors up to 185.000 m2. Low interest loans and tax credits were also available during this period.

The campaign of 84-86 mentioned above, as well as a new one performed in cooperation with the Public Power Corporation in 1995, helped the solar systems to penetrate considerably in the residential sector.

Trying to support the application of central solar systems in the tertiary and the industrial sector, which is still low, the Operational Programme for Energy (1996-2000) supported a significant number of solar systems in Hotels and Industry by financing up to 50% of the capital cost.

Following official adoption of the Action Plan "Energy 2001" by the Hellenic Government, significant tax incentives for (domestic) RES installations and systems were introduced by Law 2364/1995: up to 75 % of the total cost for the purchase and installation of domestic RES appliances and systems can now be deducted from the taxable income of natural persons. It is estimated that the tax deduction of Law 2364/1995 can reduce the cost of domestic RES systems (e.g. of solar heaters) by up to 30 %.

"Energy 2001" was further reinforced by the enactment of M.D. 21475/98, which incorporated the provisions of Council Directive 93/76/EC (EU Save Directive) for the stabilisation of CO2 emissions and the efficient use of energy in buildings.

Concerning the incorporation of RES systems in buildings, the M.D. 21475/98 specifically refers to:

- active solar systems (ASS), such as hot water solar heaters and photovoltaic modules
- other (non-specified) RES systems, which may convert renewables to electricity or thermal energy.

National policies related to the implementation of European energy and environmental targets

In the frame of the implementation of the *'Energy Performance Building Directive 2002/91 of the EC and the Council*', the 'Regulation for Thermal Insulation' is going to be replaced by the new 'Regulation on Energy Efficiency of Buildings' which sets as obligatory the energy design of all buildings, specific energy consumption limits (per climate zone), materials properties and performance and calculation methodologies for H/C/L.

Degree of awareness of main key actors (architects, construction companies, associations, main stakeholders, etc)

For the dissemination and the further promotion of the solar thermal systems in Greece, a considerable number of activities have already taken place, such as mass media campaigns, advertising, implementation of workshops business oriented, web and journal publications, technical brochures productions, etc.

One of the greatest campaigns regarding thermal solar systems was a large TV promotion campaign undertaken by EBHE (the Hellenic Solar Industry Association) with financial support by the State in 1984 and 1986. This has contributed to increased sales. Another campaign in two phases over the period 1994-1995 was co-financed by EU OPET Programme and manufacturers and included a TV campaign and direct mailing through the bills of the Public Power Corporation (PPC). This Campaign was collaboration between CRES, EBHE and PPC, with encouraging results.

A parallel series of promotional and raising awareness activities funded by the European Commission, have been carried out during the last 15 years, mainly

through the THERMIE and ALTENER programmes, focusing both on the demand and the supply side.

4. Current status of solar energy technology applications

There are two types of active solar systems: The systems of natural circulation and the systems of forced circulation. The first two are separated in two categories:

- The compact heaters or as they are also called, the integrated systems of collector-storage, which are constituted from one or more storage tanks and they are placed in an insulated jacket with their transparent side facing the sun.
- The thermosyphoning systems, which are based on the natural transfer for the water circulation in the collectors and the tank, which tank is placed on top of the collector. As the water heats up in the solar collector becomes lighter and rises up naturally towards the storage tank while the cooler water of the tank flows via the piping system towards the lower part of the collector generating in that way circulation in the whole system.

Applications

- Domestic Hot Water Production
- Space heating and cooling
- Desalination
- Pool Heating

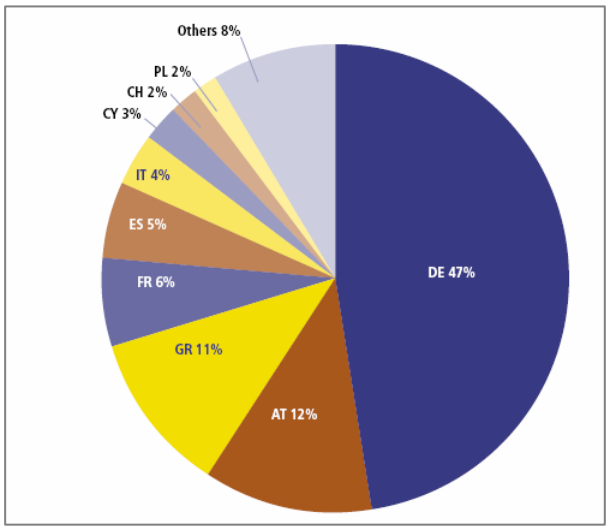
Regarding the use of solar systems, 99% of them are small scale systems for domestic hot water, 0.75% are large scale systems for hot water in the tertiary sector (hotels, hospitals and swimming pools) and 0.17 % (5,118 m2) are large systems for hot water, air-conditioning and space heating in industry (*Ref. EBHE*).
About 20 % of Hellenic households use thermosiphonic solar systems for production of sanitary hot water.
The great majority (more than 95 %) of solar sanitary hot water systems installed in Greece regards compact thermosiphonic units, providing hot water to individual dwellings. A typical configuration of such a system comprises a simple flat plate collector (single- or double-glazed) and a storage tank attached above the collector.

Further to the wide application for domestic use, the second larger customer of Solar Thermal Systems in Greece is hotels and hospitals.
Over 100 hotel units in Hellas have large thermal solar systems for sanitary hot water production, swimming pool heating and solar air-conditioning. The market rises up to 28,820 m2 for the large solar systems and up to 35,000 m2 for the thermosyphonic type solar systems. Both parts share a 2.2 % of the total solar collector stock of Hellas. The average size of large solar system in Hellenic hotels is 257 m2, while the largest one is 2,783 m2.

Among the operational systems of the Renewable Energy Sources, the active solar systems are the ones with the larger penetration in the market.

Market size in terms of collector area (m^2) in Greece							
In operation	Market (= newly installed)					Market Growth	Market Forecast
2006	2004	2005	2006			2006/2005	2007
Total Glazed m2	Total Glazed m2	Total Glazed m2	Total Glazed m2	Rate plate m2	Vacuum collectors m2	Total Glazed %	Total Glazed m2
3.287.200	215.000	220.500	240.000	235.200	4.800	9%	300.000
Market size in terms of capacity (kW_{th})[1] in Greece							
In operation	Market (= newly installed)					Market Growth	Market Forecast
2006	2004	2005	2006			2006/2005	2007
Total Glazed kW_{th}	Total Glazed kW_{th}	Total Glazed kW_{th}	Total Glazed kW_{th}	Rate plate kW_{th}	Vacuum collectors kW_{th}	Total Glazed %	Total Glazed kW_{th}
2.301.040	150.500	154.350	168.000	164.640	3.360	9%	210.000

Ref: European Solar Thermal Industry Federation (ESTIF)



Solar Thermal Capacity in Operation (ESTIF 2005)

The application of active solar systems in Greece[1] started in mid 70's. The use of electric heaters in almost every Greek household, in combination with the oil crisis, and the rising price of electricity during this period, provided the background for the solar market to develop (EBHE – the Greek Solar Industry Association - was created in 1978). The advertising campaigns of large firms helped a lot in the initial phase of the establishment of the solar market.

Until 1987 the market was steadily rising. In 1984-1986 a large advertising campaign supported by the Greek government, combined with financial incentives, boosted the sales of glazed solar collectors up to 218,000 m2. It was considered that there were about 300 "manufacturers" of solar systems at that time. All the systems were locally produced except from some imported, mainly from Israel.

Since 1987 the market's growth rate has stabilised mainly because:

- The financial constraints slowed down the rate of construction of new buildings
- The oil price started going down as the oil crisis ended
- The electricity tariffs remained low resulting in the decrease of the competitiveness of solar systems.

The campaign of 84-86 mentioned above, as well as a new one performed in cooperation with the Public Power Corporation in 1995, helped the solar systems to penetrate considerably in the residential sector.

Success stories - Lessons learned

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

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

According to the experience that gained all these years through the campaigns and promotional actions for Solar Thermal Technologies, a general Strengths, Weaknesses, Opportunities and Threats Analysis (SWOT) concerning the Hellenic Market is presented:

[1] "Collection of statistical data on Solar Energy Applications in Greece", C.R.E.S - Department of Energy Information Systems, European Commission – EUROSTAT 2001

strengths	▪ mature technology ▪ economically reasonable ▪ comfort for the consumer
weaknesses	▪ need to train the plumbers or other installation personnel ▪ inadequate international labelling ▪ integration of STT in the architecture ▪ low advertising budget ▪ low environmental awareness in some regions
opportunities	▪ high energy cost ▪ on time penetration in new developing markets ▪ STTs usually have positive social acceptance and more comfort for the consumer ▪ EU environmental policy and subsidy Programmes ▪ ‚joint ventures with new trade partners)
threats	▪ seasonality ▪ competition from countries with low labour cost ▪ discredit due to bad previous examples ▪ environmental sensitivity of the consumers

5. Barriers impeding building integrated solar technologies

Since 1987, the market has decreased due principally to:

- oil prices decrease after the end of the oil crisis
- reduced electricity tariffs, influenced by governmental social policy, have decreased the competitiveness of solar systems
- financial constraints slowed down the rate of new buildings construction
- removal of all existing incentives and the lack of support of solar systems in the future
- limited budget was available for promotion campaigns and development because the manufacturers suffered from sales decrease and lack of funds.

6. Future opportunities and plans, most promising market niches

In order to achieve further penetration of solar thermal applications in the industrial and building sector Hellenic key players have to:

- Further advertise the products.
- Raise environmental awareness.
- Improve installation and product quality.
- Implement promotion campaigns to engineers, architects, installers
- Implement promotion campaigns for large systems
- Further penetrate solar systems in the public sector
- Continue subsidisation and incentives
- Introduce green taxes

Solar industry represents a well-developed manufacturing sector in Greece. 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. Greece is the largest exporter of solar systems in Europe. The production of the sector covers about 30 % of the European market.

For a more marketing oriented development of solar thermal technologies, according to the relevant campaigns-actions, critical is the role of the level of public awareness of environmental problems, the support of solar thermal energy by governments and the development of creative marketing strategies by market actors.

Among the major barriers for innovative solar thermal applications to enter energy markets is the lack of rational marketing planning and sufficient marketing activities. Consequently there is a need for a reliable marketing strategy, planned and adapted to different types of markets.

Priority projects per sector [2]

SECTOR	*Candidate demonstration projects*	*Proposed marketing tool*	*Key actors*	*Commends*
DOMESTIC SECTOR	• installation and other standards, if necessary different standards will be defined for South and North Europe • remote village demonstration projects	• large scale advertising campaigns (TV, press) • financial incentives • direct mailing of information material • labelling of equipment, guarantees for results	• owners • architects • local authorities • manufacturers • installers • Ministries	• integration with bioclimatic architecture • information on the environmental impacts of fossil fuels
PUBLIC BUILDINGS (HOSPITALS, SCHOOLS, SPORTS FACILITIES, MUNICIPAL BUILDINGS, ETC)	• monitoring of the energy consumption • selection of areas for demos • solar thermal demonstration house in Hungary	• maxi-brochures • technical surveys • legislative framework • seminars, workshops • business trips • market analyses	• local administration • industry • Ministries • tourist authorities • legislative changes/ regulations	• integration in social buildings
COMMERCIAL BUILDINGS (HOTELS, BANKS, INSURANCE COMPANIES)		• maxi-brochures • workshops • seminars • financial incentives • technical press • financing	• insurance companies • banks • private owners • sectorial associations	
INDUSTRY	• solar thermal power generation equipment	• study visits in sites • technical press • financing • training for decision makers	• engineers • private owners • energy supply companies • industrial executives	
ALL THE ABOVE	• reliability of solar equipment • standardisation of the components • identification of the appropriate market sectors	• manufacturers seminar • financial support • training of the installers	• EU • national & regional Authorities • industrial associations • financial institutes	• to strengthen the credibility of solar equipment

Although the market is not uniform in the EU regions it is obvious that some common activities are necessary to transform the market from a niche to a commodity one. These activities could support the sustainable penetration according also to the European Commission's White Paper. These activities can be grouped as follows:

- Motivation of the population (image campaigns to raise public awareness, information on the economic benefits associated with STTs, increase of environmental awareness, subsidy programs as incentives to install a solar plant)
- Technical development of the product (increase of the reliability, adaptation to household technology –e.g. hot water supply-, integration in the building - e.g. in the roof or façade-, development of innovative applications - e.g. solar cooling-, cost reduction)

[2] "Collection of statistical data on Solar Energy Applications in Greece", C.R.E.S - Department of Energy Information Systems, European Commission – EUROSTAT 2001

- Distribution and sales (creative marketing strategies, inclusion in the product range of heating traders - wholesale, retail -, building distribution networks, training of personnel in distribution and sales)
- Craftsmen and Consumers information (perception and marketing by craftsmen, technical training of craftsmen, information material available to craftsmen for consumer consulting)
- Other activities (acceptance by decision makers of the building sector - architects, house technology planners, etc.-, integration in demonstration projects/architecture competitions)

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