SOLAIR

Increasing the Market Implementation of Solar Air-Conditioning Systems for Small and Medium Applications in Residential and Commercial Buildings

Solar air-conditioning

Contents

Solar Cooling; an Intelligent Option

SOLAIR PROJECT

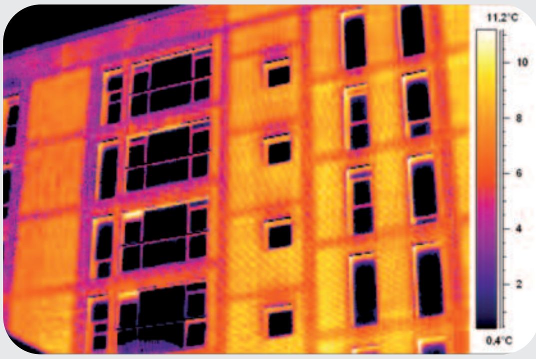
SOLAIR project was launched under the framework of the European Union's Intelligent Energy Europe Programme in the beginning of 2007 and ran until the end of 2009.

The project aims at the acceleration of the growth of small (bellow 20 kW) and medium sized (20 kW–105 kW) SAC (Solar air-conditioning) applications, through resolving major market obstacles such as, limited awareness on know-how, lack of reliable design instruments and technology information.

To carry out this work, the project consortium is formed by 13 partners of 9 European countries; Austria, Italy, Greece, Spain, The Netherlands, Germany, Portugal, France and Slovenia.

www.solair-project.eu

“80 % of the greenhouse gas emissions in Europe still come from the energy sector” warns a report from the European Environment Agency.



In most European countries the electricity consumption for air-conditioning is increasing dramatically and it is expected an increasing by a factor of 4 in 2020. The reasons for this greater than ever demand for air conditioning are manifold, such as, improved comfort habits, currently still low energy costs, architectural trends like an increased fraction of glazed areas in buildings and last but not least, slowly changing climate conditions. And with the higher demand come several problems: the extensive use of electrically driven cooling is leading to capacity straining power demand peaks in the summer and increasing of green house gas emissions – either through leakage of cooling fluids or use of non-sustainable energy. Thus, improved building concepts, targeting on reduction of cooling loads by passive and innovative measures, and the use of alternatives in coverage the remaining cooling and heating demands of buildings, are of interest.

Solar cooling is an eminently smart technology because demand and supply of energy often coincide: solar radiation is abundantly available especially in the summer time, where the need for air-conditioning is the highest. And solar air-conditioning technologies have proved, some during more than ten years, their efficiency and reliability. These technologies use harmless cooling fluids (water generally) and less primary energy than the conventional systems. Therefore it is about time to start using solar energy for the purpose of keeping indoor conditions during the summer comfortable.

European households have increased their electricity consumption by 31% in the last 15 years, in spite of an average increase by 17% in end-user electricity prices compared to the mid 1990s.

Over 54% of the energy used in Europe in 2006 was imported from outside its borders. Oil comprises the bulk of total EU energy imports (60%) followed by gas (26%) and solid fuels (13%).

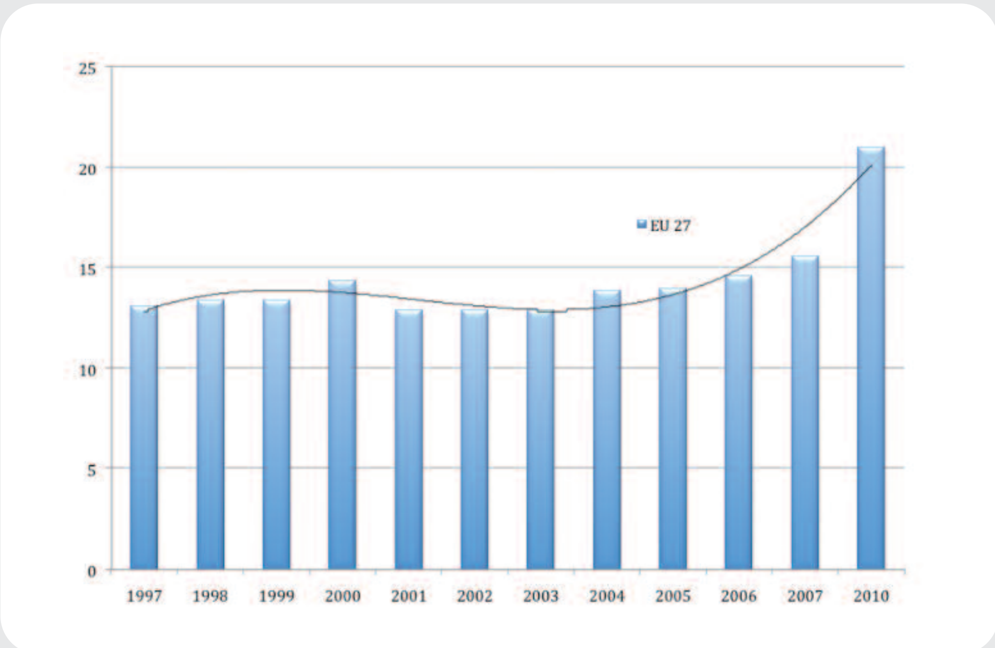


Figure 1
Electricity generated from renewable sources (EU 27) - % of gross electricity consumption (2010 forecast). Source: Eurostat.

SAC Technology Today and Tomorrow

*European Solar Thermal Technology Platform **(ESTTP) describes the research efforts and infrastructure needed to reach the goal of supplying 50% of the energy needed for heating and cooling with solar thermal energy.***
Among the top priorities are compact heat storages, solar thermal for industrial processes, and solar cooling.

*The classification into **'small'** and **'medium' installations** aligns with available chiller products; small applications are in this sense, systems with a nominal chilling capacity below 20 kW, and medium size systems may range up to approx. 100 kW.*

It is true that SAC installations have proven their effectiveness in recent years but small and medium size plants are not still widespread into the market.

The latest survey on solar cooling systems, executed in 2007 within the Task 38 'Solar air-conditioning and refrigeration' in the Solar Heating and Cooling Programme of the International Energy Agency (IEA), comprises 81 plants. The installed chilling capacity amounts to 9 MW, with approx. 24,000 m² of installed solar collectors. 81% of the plants in this survey are producing chilled water for building air-conditioning; in the remaining 19% solar heat is used for direct conditioning of fresh air in plants with sorptive supply air dehumidification. The share of applications is shown in figure 2. In more than 50% of the installations, flat-plate solar collectors are used.

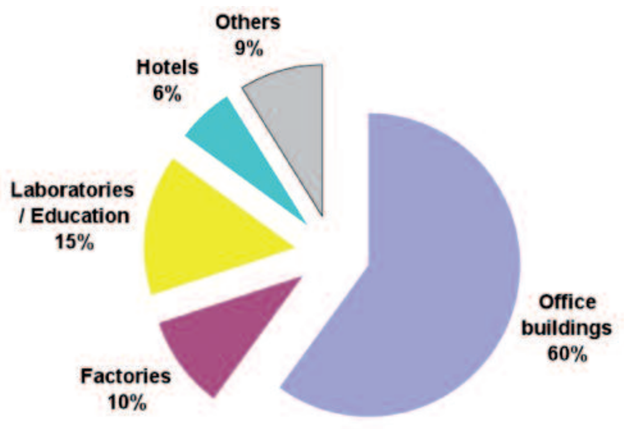


Figure 2
Application sectors of solar cooling. Source: Survey carried out by EURAC within IEA-SHC Task 38.

In between, especially in southern European countries (e.g., Spain) an increase in small size solar cooling systems for residential application is observed. However, the total number of systems currently in operation in Europe is not very well known, but may be estimated to 200 – 300 installations.

Systems in the small capacity range are usually consisting of thermally driven chilled water systems, whereas medium sized systems may be open cycle desiccant evaporative cooling (DEC) systems (direct conditioning of fresh air regarding humidity and temperature) as well.

Chilling methods

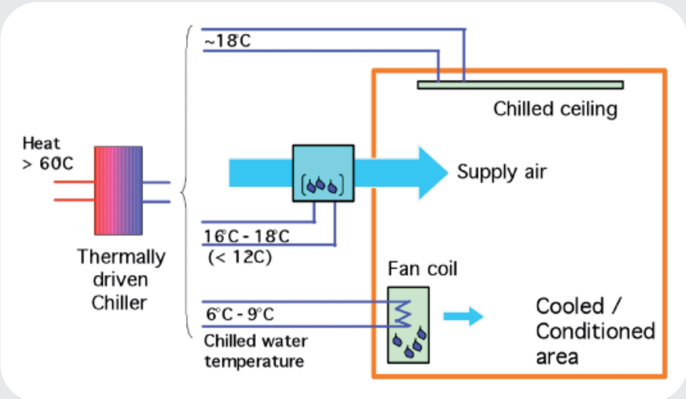
In all SAC solar heat is used to drive a cooling process. Generally, SAC can be distinguished into:

Closed cycle systems

Closed cycle systems are equipped with thermally driven chillers, which provide chilled water that is either used in air handling units to supply cooled and dehumidified air or that is distributed via a chilled network to decentralized room installations such as fan coils or chilled ceilings. Available thermally driven chillers on the market are absorption chillers, which are most common, and adsorption chillers, offered currently by few manufacturers only. The role of a solar collector system is to provide driving heat at appropriate temperature to the chiller. An additional component, necessary in all chilled water systems, is a heat rejection system.

Open cycle systems

Open cycle systems allow complete air-conditioning by supplying cooled and dehumidified air. The “refrigerant” is always water, which is brought into direct contact with the atmosphere. Chilled water is not produced. The most common open systems are desiccant cooling systems (DEC) with a rotating dehumidification wheel and a solid sorbent. New developments use liquid sorption. The role of the solar collector is to provide regeneration heat to the dehumidification unit.



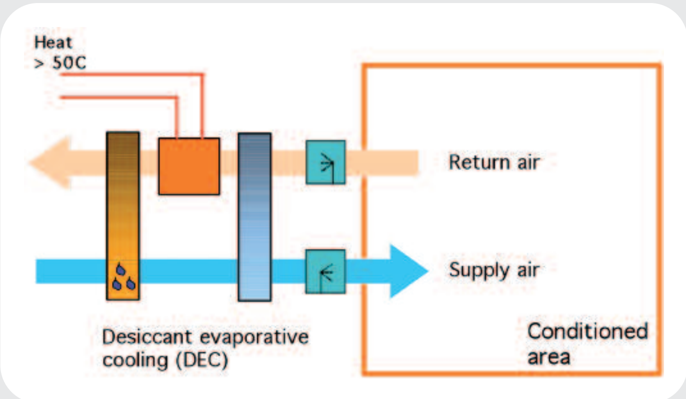


Figure 3
General types of thermally driven cooling and air-conditioning technologies. In the figure above, chilled water is produced in a closed loop for different decentral applications or for supply air cooling. In the figure below, supply air is directly cooled and dehumidified in an open cycle process. Source: Fraunhofer ISE.

Examples on the specific collector area per kW thermally driven cooling capacity is given in figure 4.

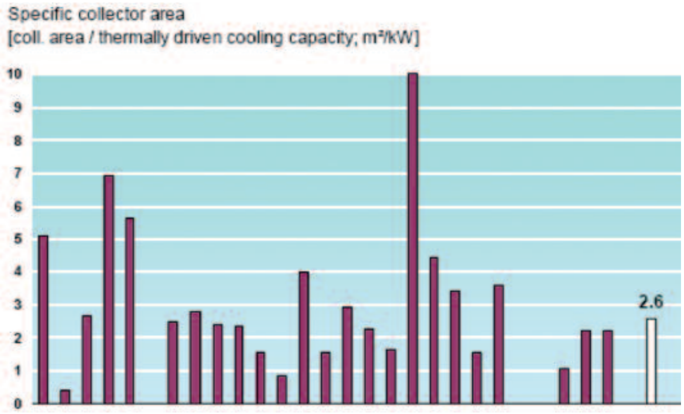
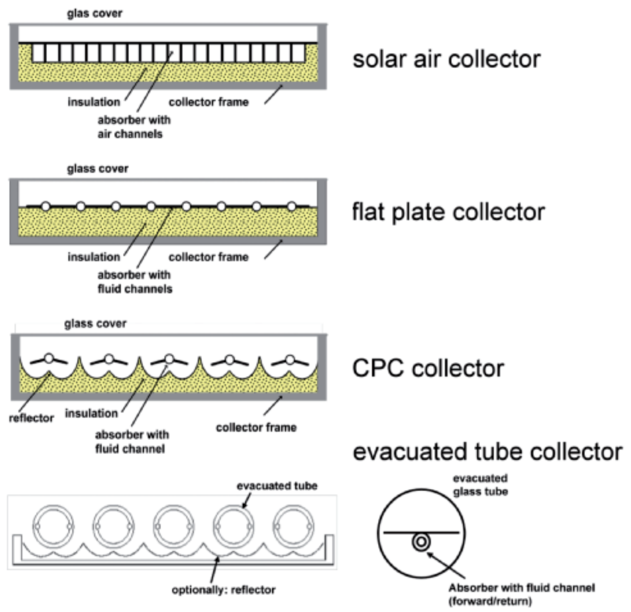


Figure 4
Examples on the specific collector area per kW installed thermally driven cooling equipment for systems in the SOLAIR database. For the whole data set, the average specific collector area is indicated by the white bar right hand side, determined from integrated values of collector area and capacity. Source: SOLAIR database, available in SOLAR'S website.

Solar thermal collectors

The appropriate type of collector depends on the selected cooling technology and on the site conditions, i.e., on the radiation availability.



METHOD	CLOSED CYCLE		OPEN CYCLE	
Type of refrigerant cycle	Refrigerant flows in closed cycles		Refrigerant is in direct contact with air	
Principle	Chilled water		Dehumidification of air and evaporative cooling	
Phase of sorbent	Solid	Liquid	Solid	Liquid
Typical material duo	Water – silica gel Water - zeolite	Water – lithium bromide Water - lithium chloride Ammonia - water	Water – silica gel Water – lithium chloride	Water – calcium chloride Water – lithium chloride
Available technology	Absorption chiller	Absorption chiller	Desiccant cooling	Close to market introduction
Typical cooling capacity	7 – 430 kW	10 kW – 5 MW	20 – 350 kW (per module)	0.5 > 1
Typical coefficient of performance*	0.5 – 0.6	0.6 – 0.75 (single effect)	0.5 ≥ 1	0.5 > 1
Typical driving temperature	65 – 90 °C	80 – 110 °C	50 – 80 °C	50 – 70 °C
Solar collectors	Tubes, flat plate	Tubes, flat plate	Flat plate, air collectors	Flat plate, air collectors

** Coefficient of Performance (COP) = chilling capacity / driving heat*

Water storage

A hot water storage is in almost all of the systems installed, but the specific storage volume (liter per m² collector area) differs in a wide range, as figure 5 shows. Only two desiccant cooling systems, using air-collectors, do not include storages. The optimal storage size cannot be assessed from this figure, since it is subject on the type of irradiation availability, collector type, preferred driving temperature, control strategy and of the cooling load pattern.

Step by step

In the very beginning of planning a solar cooling and air-conditioning system, the appropriate technology has to be identified. A basic decision scheme as shown in the figure below assists the selection of a technology path for solar thermally assisted air-conditioning. (Details on the handling of this scheme are outlined in the Guideline document, accessible from the SOLAIR web pag: http://www.solair-project.eu).

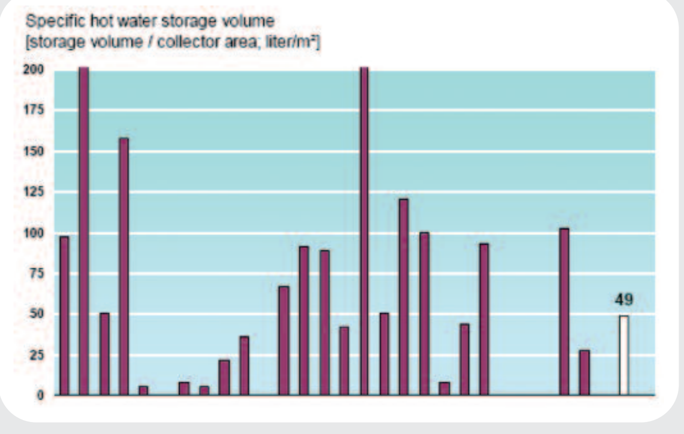


Figure 5
Examples on the specific hot water volume in liter per m² collector area from installations in the SOLAIR database. For the whole data set, the average specific hot water storage volume is indicated by the white bar right hand side, determined from integrated values of storage volume and collector area (excluding data of two air-collector systems and one system with seasonal storage). Source: SOLAIR database.

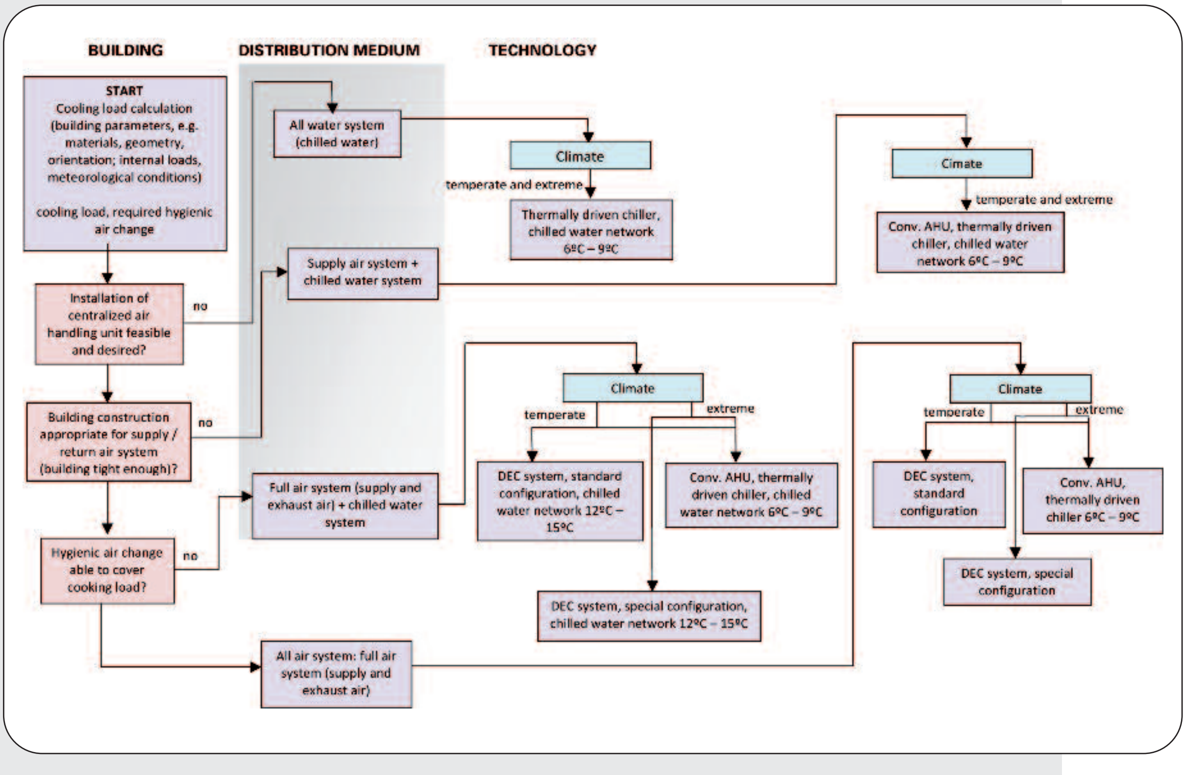


Figure 6
Planning scheme of a solar cooling and air-conditioning system. Source: Fraunhofer ISE.

Sucess Stories

Europe fosters European citizens' interest in their community by highlighting examples of positive involvement, initiative and innovation.

A "Best Practice Catalogue" exists with additional installations which are noteworthy:
(www.solair-project.eu)

Residence du Lac, Maclas, France

Description of the application

The targeted building welcoming the solar cooling application is the Résidence du Lac, a building dedicated to retired people. This building is sitted in the village of Maclas in the Rhône Alpes area, close to Lyon. The village is in altitude, nearly 450 m high.

The building was created in the seventies and is of an average quality level for the energy efficiency. Only one small part of the building is cooled, the leisure space/restaurant which is compulsory since summer 2003 in retired buildings. This area is of 210 m² and includes a veranda oriented in the Southern direction. Efforts were made to increase the solar protection level in the veranda by adding dark thin protection films. Till 2007, the building owner used electric compression chillers (3 monosplits). Two of them were out of order in 2007 and the management took the decision with the help of the SIEL (Syndicat Intercommunal d'Energie de la Loire) to go for a solar cooling system. The owner of the system is the SIEL itself.

General description of the system

The system is based on an absorption chiller of 10 kW coupled with evacuated tube collectors. The system is in configuration of a quasi solar autonomous cooling system because only a small electric compression chiller (splite type) is used in case of failure of the solar system. The load of a part of the entire building is based on the following scenario: cooling demand from June to *mid September and heating demand from *mid October to end of May. The solar system is using fan coils for the cooling and heating modes but thanks to a buffer storage, it can be valorized as well in the heating mode through the central heating network of the Résidence du Lac. The heat rejection system is done by a drycooler sitted in the Northern facade of the building.

Central air conditioning unit

Technology:	***Closed cycle***
Nominal capacity:	*10* kW_{cold}
Type of closed system:	*Absorption*
Brand of chiller unit:	*Sonnenklima*
Chilled water application:	*Fan coils*
Dehumidification:	*No*
Heat rejection system:	*Dry*

Solar thermal

Collector type:	*Evacuated tube*
Brand of collector:	*Thermomax Mazdon 20*
Collector area:	*24* m^2 *absorber area*
Tilt angle, orientation:	*Tilt 30°, 15° west*
Collector fluid:	*Water-glycol*
Typical operation temperature:	*75°C*

Configuration

Heat storage:	*0,5* m^3 *water*
Cold storage:	*Buffer water (80 liters)*
Auxiliary heating support:	*None*
Use of auxiliary heating system:	
Auxiliary chiller:	*Yes*
– Type:	*el. compression chiller*
– Capacity:	*3* kW_{cold}

System performance

Energy production expectations:

– Cooling: 4,300 kWh/year (4 months)
– Heating: 8,300 kWh/year (8 months)
TOTAL = 12,600 kWh/year

Energy savings:

– Cooling: 5 ç€/kWh (EER = 2; bad quality split)
– Heating: 6 ç€/kWh (fuel burner; 85%)
– Electricity consumption: 845 kWh = 42 €/year
TOTAL = 1,150 €/year (on the basis of an average increase of energy price of 5%/year)

General information

Type of building:
Retired people residence

Location:
Maclas

Auxiliary heating support:
Fuel (central heating net)

In operation since:
2007 (July)

System operated by:
SIEL

Air conditioned area:
210 m^2

– Capacity: *10 kW*

CNRS PROMES Research Center Office in Perpignan, France

Description of the application

The targeted building welcoming the solar cooling application is the CNRS PROMES research center office. It is dedicated to research works and offices in the technical area TECNOSUD of Perpignan located in Languedoc Roussillon area (South of France). The building is a large building of more than 5000 m² made of 3 levels and the solar cooling system is located on the ground floor and producing energy only for a small proportion of the building. The general orientation of the building is North/South (45° tilt) and the collector field is oriented in the same direction on the roof. The building was created in 2000 and is of good quality level for the energy efficiency.

General description of the system

The system is based on an adsorption chiller of 7,5 kW coupled with 24 m² double glazed flate plate collectors. The system is producing independantely energy in parallel of a general multi split compression chiller system.

The distribution system for the solar cooling system is an independent chilled/hot water network using fan coils working at 14/18°C temperature level.

The heat rejection system is done by a drycooler assisted by a spring water spraying device, only used in case of very hot days.

Technical information

Technology:	***Closed cycle***
Nominal capacity:	*7.5 kW_{cold}*
Type of closed system:	*Adsorption*
Brand of chiller unit:	*SORTECH*
Chilled water application:	*Fan coils*
Dehumidification:	*No*
Heat rejection system:	*Dry cooling tower with adiabatic spraying*

Solar thermal

Collector type:	*Double Glazed Flat Plate collectors*
Brand of collector:	*Schüco*
Collector area:	*25 m² absorber area*
Tilt angle, orientation:	*30°, 45° East*
Collector fluid:	*Water*
Typical operation temperature:	*75°C*

Configuration

Heat storage:	*0,3 m³ water*
Cold storage:	*0,3 m³ water*
Auxiliary heating support:	*None*
Use of auxiliary heating system:	*No*
Auxiliary chiller:	*Yes*
– Type:	*el. compression chiller*

System performance

Energy production monitored (2008-2009):

– Cooling: 2 500 kWh/year (5 months on 12)

– Heating: 4 000 kWh/year (6 months on 12)

Energy savings:

– Cooling & heating : 10 ç€/kWh (ESEER = 2; average quality multisplit split)

– Electricity consumption: 580 kWh = 58 €/year

TOTAL= 540 €/year (on the basis of an average increase of energy price of 5%/year)

System reliability and overall success of the installation

The system has been working properly for more than 1.5 years on cooling and heating mode. The avera overall electrical COP (electrical efficiency of the solar system) has reached an average of 10 on a yearly monitoring duration. The building owner is satisfied by the solar cooling and heating system. However, nearly 10% of the annual solar ressource cannot be valorised because the targeted building has no need of heating nor cooling in April (example in 2009) even if the drainback system on the collectors' field is protecting the system from overheating risks.

General information

Type of building:
Office building

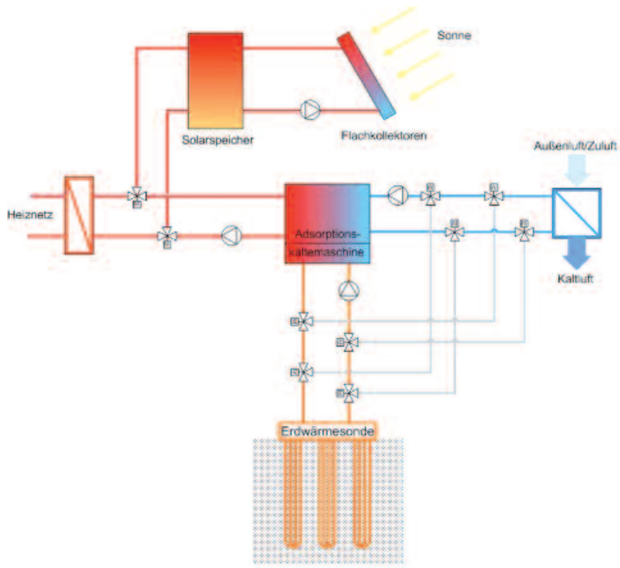
Location:
Perpignan

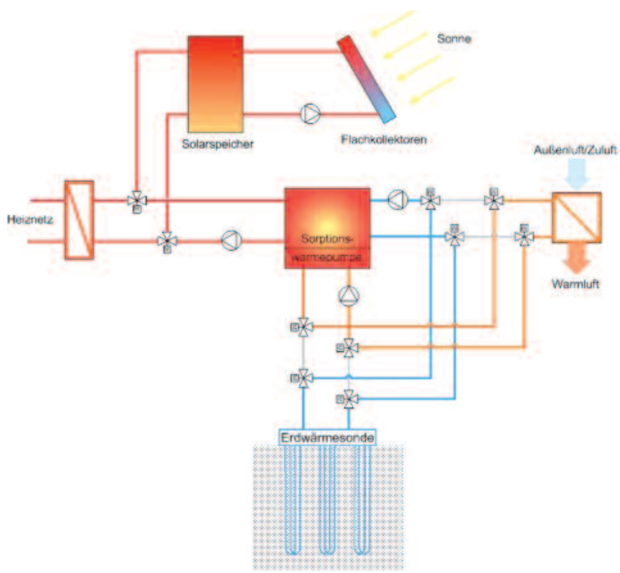
Auxiliary heating support:
None

In operation since:
2008 (July)

System operated by:
Neotec

Air conditioned area:
180 m²
– Capacity: 7.5 kW





Fraunhofer ISE, Freiburg, Germany

Description of the application

The Building or Fraunhofer Institute for Solar Energy Systems (ISE) is an energy efficient building with passive cooling measures. An exception is the canteen kitchen area, where due to high internal loads active cooling of the supply air is appropriate. This is done by means of a small size thermally driven chiller.

General description of the system

The system technology is a closed cycle chilled water system with an adsorption chiller. Heat is provided by a solar thermal system and by the heat network of the institute. During summer, the system runs in cooling mode. The medium temperature heat of the chiller is rejected by three ground tubes of 80 m each. In winter, the heat pump function of the machine is activated and the ground tubes act as low-temperature energy source. The system thus cools and heats the supply air into the kitchen.

Central air conditioning unit

Technology:	***Closed cycle***
Nominal capacity:	*5.5 x 10 kW_{cold}*
Type of closed system:	*Adsorption*
Brand of chiller unit:	*SorTech ACS 05*
Chilled water application:	*Supply air cooling*
Dehumidification:	*Occasionally*
Heat rejection system:	*Dry, ground tubes*

Solar thermal

Collector type:	*Flat-plate*
Brand of collector:	*Solvis FF 35s 3/2 FKY*
Collector area:	*22 m² aperture*
Tilt angle, orientation:	*30°, south*
Collector fluid:	*Water-glycol*
Typical operation temperature:	*75°C driving temperature for chiller operation*

Configuration

Heat storage:	*2 m³ water*
Cold storage:	*None*
Auxiliary heating support:	*Institute heat network, operated by CHP and gas boiler*
Use of auxiliary heating system:	*Auxiliary driving source for chiller, auxiliary driving source for heat pump operation in winter.*
Auxiliary chiller:	*No*

System performance

For one year of operation (August 2008 until July 2009) an average seasonal Coefficient of Performance of COP = 0.43 was observed. The solar thermal coverage of the total heat input for cooling and heating was 30%. The chiller was newly evacuated before the monitoring period. During winter, the machine runs in heat pump mode; the resulting COP in this operation mode for the whole heating season was 1.25.

System reliability and overall success of the installation

After a decrease in performance during the first operation months (inert gasses), the chiller was newly evacuated in August 2009. Apart from this, the operation was very reliable. The system concept is promising: no cooling tower is required, and a fraction of the rejected heat in summer in the borehole may be available in the low-temperature heat source during the heat pump operation mode in winter. Another advantage is the noiseless operation of the chiller.

General information

Type of building:
Kitchen area of institute

Location:
Freiburg, Germany

In operation since:
2007

System operated by:
Fraunhofer ISE

Air conditioned area:
42 m²

Residential building in Derio, Bizkaia, Spain

Description of the application

Solar cooling and heating system with absorption chiller in a residential building in Derio, Bizkaia. 200 m^2 of conditioned area are cooled and heated with a radiant floor system. The chiller allows heat pump operation during the heating season. During summer operation, heat rejection is done via the large rain water storage for irrigation.

General description of the system

The system technology for cooling is an absorption closed cycle with lithium-chloride solution. Heat is provided by a solar thermal system of heat pipe vacuum tubes panels (and an auxiliary system of oil when needed for heating and DHW) that is used for DHW, heating and cooling. The chilling capacity of the system is 10 kW with 50 kWh internal energy storage capacity, with a nominal driving heat temperature of 70-75 °C. The heat rejection system consists of a large storage of 30 m^3 volume with natural water exchange through use for irrigation and refilled with rain water. No wet cooling tower exist. During summer (mainly in June, July and August) the system runs in cooling mode and in heat demand mode in winter (December, January, February and March). Hot water is required all year round.

Central air conditioning unit

Technology:	***Closed cycle***
Nominal capacity:	*10 kW$_{cold}$*
Type of closed system:	*Absorption*
Brand of chiller unit:	*ClimateWell*
Chilled water application:	*Radiant floor*
Dehumidification:	*No*
Heat rejection system:	*Irrigation storage tank*

Solar thermal

Collector type:	*Vacuum tube (heat pipe)*
Brand of collector:	*Wolss Sunrain*
Collector area:	*21.6 m^2 aperture*
Tilt angle, orientation:	*45° south*
Collector fluid:	*Water*
Typical operation temperature:	*75°C*

Configuration

Heat storage:	*0.6 m^3 water*
Cold storage:	*None*
Auxiliary heating support:	*Oil*
Use of auxiliary heating system:	*Space heating, space cooling and hot water*
Auxiliary chiller:	*No*

System performance

The monitoring data collected has not been jet analyzed or evaluated.

System reliability and overall success of the installation

Although quantitative data are missing for reliability analysis, the owner of the system is satisfied with the performance.

General information

Type of building:
Residential

Location:
Derio

Auxiliary heating support:
Yes

In operation since:
2007

System operated by:
Lansolar

Air conditioned area:
200 m^2
– Capacity: *10 kW*

Present and Future

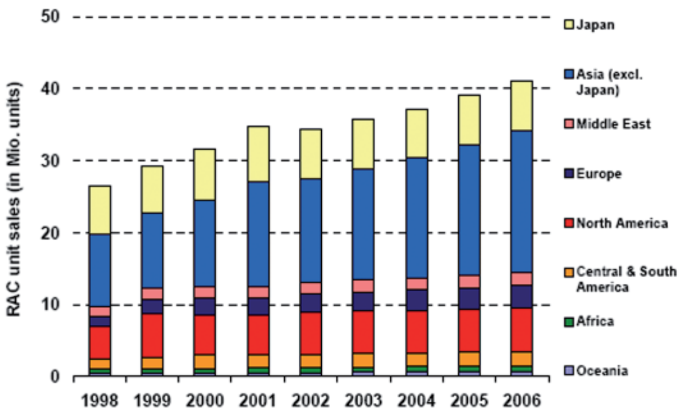


Figure 7
Annual sales of small room air conditioners (RAC units). Source: F. Butera: "The use of environmental energies for sustainable building in Mediterranean climates; Intelligent Building Middle East, Bahrain, December 2005".

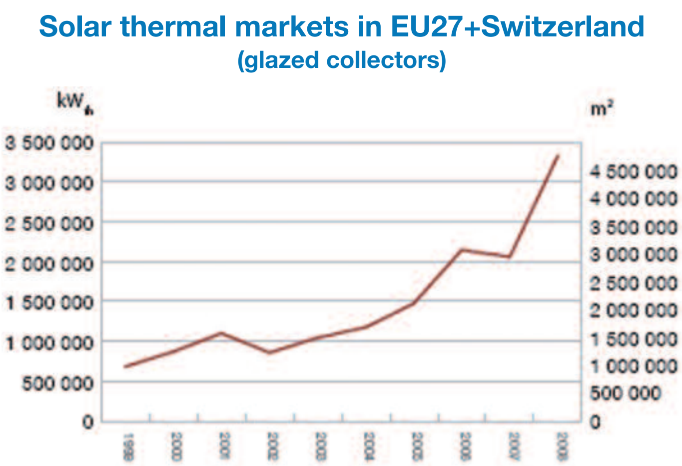


Figure 8
Solar thermal market of glazed collectors in the EU and Switzerland. Source: STIF, Solar Thermal Markets in Europe, May 2009.

In the last years a great increase in the market for air-conditioning has been observed worldwide. The figure 7 shows the sales rates of room air-conditioners (RAC units) in different regions of the world. The number of sold units increased from about 26 million units worldwide in 1998 to more than 40 million units in 2006 (forecast). At the same time, the market for centralized cooling equipment remained almost stable.

In the other hand, solar thermal market is experiencing a continuous growth not only in Europe but around the world.

The growth potential of solar thermal technology is possible due to solar radiation, which can be made most of it profitably around the world

All these favourable conditions make solar cooling an excellent choice and demonstrate the great potential of this technology. Solar cooling is at the edge of wide market introduction and as a consequence considerable cost reduction is expected in short-medium term.

The main advantages of solar thermal technology are:

- Reduces the dependency on imported fuels.
- Improves the diversity of energy supply.
- Saves scarce natural resources.
- Saves CO_2 emissions.
- Curbs urban air pollution.
- Is proven and reliable.
- Is immediately available - all over Europe.
- Owners of systems substantially save on their heating/cooling bills.
- Creates local jobs and stimulates the local economy.
- Inexhaustible.

Economical and Environmental Benefits

Solar cooling is a smart choice in the sense that reduces both electricity consumption, which in recent years has increased dramatically due to the needs of comfort in summer time, and the use of polluting and harmful refrigerants. Furthermore, due to the characteristic of being an energy that it is consumed where it is produced, it decreases energy dependency.

Today, solar thermal already provides more than 40.000 full-time jobs in Europe (approximately 1 full-time job per 80 kW_{th} of newly installed capacity). By developing new applications such as solar cooling or solar heat for industrial processes, the industry is already working on systems of tomorrow. Renewable energy industries have become leaders in market and job growth.

Investment cost for the total system (from SOLAIR database), comprising collector, collector support, storages, chilled water system, heat rejection, installation and monitoring, are shown in figure 9 (thermally driven chilled water systems) and in figure 10 (DEC systems).

The cost figures have to be interpreted with care for different reasons:

- Most of the installations are still demonstration systems and thus special effort was made in system planning, configuration and monitoring. In some applications, the monitoring cost alone surpasses the pure investment cost for a conventional system installation.
- In the majority of the systems, the collector additionally supports heating of the building as well.
- The medium and small sized chillers have not yet really competitive component costs due to individual manufacturing processes. Mass production of some chiller products is in the beginning, thus, a high potential for cost decrease can be assumed here.
- In general, the investment cost alone are not sufficient to assess the economic situation of a solar cooling system. A more precise economic evaluation e.g., on base of annuity method including maintenance and operation costs and an assessment of the costs of an corresponding conventional system solution is required for such assessments. This is not topic of SOLAIR.

Specific cost
(total investment / thermally driven cooling capacity, €/kW)

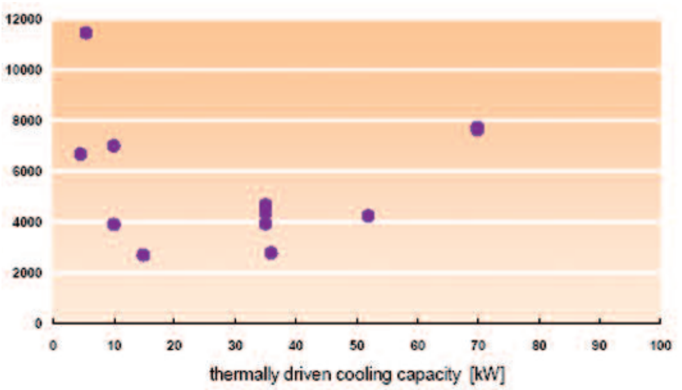


Figure 9
Specific investment cost for systems with thermally driven chiller presented versus chiller capacity. Source: SOLAIR database.

Total cost
(total investment / nominal air flow rate DEC; €/m³/h)

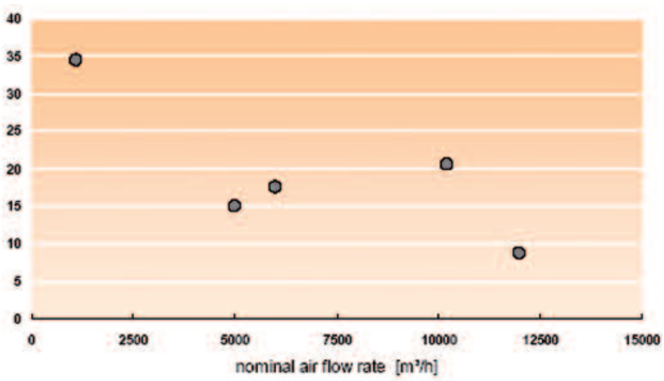


Figure 10
Specific investment cost for DEC systems, presented versus the nominal air flow rate of the air handling unit. The cost for the liquid DEC installation in Germany are not included, since in this system several components were sponsored by the providers.Source: SOLAIR database

Have Your Say

The interviews want to offer the perspective on this technology from such diverse viewpoints as from a politician, a project manager of one of major French energy actors and two technicians with responsibilities in technological associations.

DR. ULI JAKOB, Vice-president of the Green Chiller Association for Sorption Cooling e.V., Berlin, Germany.

What is your feedback on the previous experience you have had on the management of solar cooling projects ?

My personal feedback on the previous solar cooling projects is that very often the installed solar cooling systems were very complex (e.g. hydraulic part). On the other hand very often the selected installers have built their first solar cooling system in their life, which have leaded very often to a lot of installation failures (because of no training before). Therefore, it is very important that the standardization of solar cooling systems will be developed to make it more easy to manage and install such systems.

According to you, what is the solar cooling potential in Europe?

I personally think that the potential for solar cooling in Europe is quite high, especially in the southern European countries. But in general we have to raise the awareness for this technology in the public as well as in the politics in the next years very rapidly. Furthermore, it is very important that the national European governments are introducing funding schemes for the domestic market especially for solar cooling (e.g. to fund 50% of the total investment of such systems). With that the total number of installed systems will be increasing and with that the total system costs should come down.

What is the position of Green Chiller Association, one of the key association, on this field of solar cooling?

The Green Chiller Association for Sorption Cooling is a German industry association, which is not only focusing on solar cooling but also on thermal cooling with district heat or waste heat from CHP units, biomass, industrial processes, etc. Therefore, solar cooling is an important topic for our members to develop markets for their products. But it is quite important for developing the markets, that our universities should offer new or more bachelor or master courses dealing with renewables in general so that more engineers with thermal cooling know-how are available. Furthermore, all the installers and planners have to be trained that they get the know-how to design or install such solar cooling systems.

OSKAR ZABALA, Director of Energy and Mining of the Basque Government.

What is the present situation and future outlook for this technology (SAC)?

Worldwide, the market in air cooling and conditioning technologies is growing fast. Most of this demand is still being met using conventional electrical appliances, and the result, especially in the summer months, is an overloading of power grids.

However, the current energy situation is helping speed up the introduction of more efficient systems, and in recent years cooling apparatuses have come on the market that can operate with small-scale solar thermal power (20-50 kW). The next generation of models running at 2-5 kW are currently being tested.

Research in this technology centres on new materials, cost reduction and the development of practical guidelines and planning tools. Combi+ solar systems, which provide hot water, heating in winter and cooling in summer, are expected to take a major market share between 2020 and 2030.

Solar cooling technology, solar thermal power in industrial processes and solar desalination and other processes are all gradually but successfully making their way onto the market and are expected to play a significant role in future energy supply.

What barriers have been detected for SAC in your region and worldwide and what are the possible solutions?

An increase in funding for R&D —both from the private sector and in government budgets— will allow solar thermal energy to cover an ever greater share of the demand for low and medium temperature heat. Integration with other building and heating technologies and a reduction in costs will ensure that many solar thermal solutions will be adapted in heating and cooling.

Like other renewables, in order to grow properly it needs a reduction in regulatory and administrative barriers, improvements in information and training, and access to the grid (development of infrastructures, priority access to the grid, and certification of fitters through accredited training programmes).

What are the Basque Government's objectives and actions concerning this issue?

The aim of the Basque Government's Department of Industry, Innovation, Trade and Tourism is to promote and increase the use of solar energy in the Basque Country in climate control systems in the residential and commercial sectors.

Development of solar-powered climate control, together with the contribution made by other renewable technologies, will help the Basque Country meet its strategic targets for 2010 for these energy types, i.e. to have 12% of domestic energy consumption provided by renewable sources. They will also play a role in meeting any new targets established in the upcoming strategy review and new European policies for 2020.

For all of these reasons, the Basque Government's Department of Industry, Innovation, Trade and Tourism, together with its energy board, the Ente Vasco de la Energía has traditionally supported this industry, launching a number of annual grants schemes for projects for renewable energy installations. It has also taken part in specific European programmes on solar cooling technology, involving running publicity campaigns, seminars and training courses, targeted at different key groups in the development of this technology.

Optimal Solutions
GROUPE EDF

FABIEN RUIZ, Project Manager in EDF Optimal Solution department, France.

What is your feedback on the previous experiences you have had on the management of solar cooling projects?

There are mainly 3 steps to realize a solar cooling project: the first one is sizing, the second is manufacturing and the third one is now commissioning (testing).

Concerning the first step, we often find engineering offices making complex designs, believing they will thus master it better. In fact, the design needs to be achieved to facilitate afterwards the operation and maintenance.

For the second step, the main issue is on the works on site on a lot of different fields such as solar thermal, absorption, control, monitoring and others aspects. Generally, installers are not used with these systems and one of the means to make the process reliable is to realise and install pre-packaged systems.

And the third step with a particular importance, because permitting to optimise the system and the good operation of the dual components collectors / absorption chiller. It is indeed often forgotten that all absorption chillers have not the same features.

According to you, what is the solar cooling potential in France?

About specifically "Solar cooling", the potential of French market is located around the Mediterranean cost, in Corsica and overseas territories. However, if the solar loop is valorised as well for heating, cooling and domestic hot water production, these solutions can be installed all over in France; The asset of this technology is to permit to reach high energetic efficiency such as THPE or BBC labels.

What is the strategical position of EDF, onçe of the major French energy actors on this field?

Climate change and fossil resources scarcity lead to modify the energy consumption habits. To consume better with less greenhouse effect gas production, EDF Optimal Solutions, subsidiary company of the EDF group, is offering to private companies and local authorities low carbon solutions to reduce their energy consumption, decrease their energy bill and limit their CO_2 emissions.

EDF Optimal Solutions is delivering to clients multi-technical and multiservice integrated solutions including:

- Advice, design and/or engineering so as to guarantee the global optimisation of the energy concept.
- Installation, refurbishment, operation and maintenance of energetic systems.
- Assistance to grant request actions.
- Installation management through teleservice offers.
- Performance commitment.

That is why, naturally, solar cooling technology is a possible opportunity for EDF Optimal Solutions, because it is requiring for its management all the know how already owned by EDF Optimal Solutions. It is fitting our commitment to decrease the energy consumption and limit CO_2 emissions.

Nevertheless, it is compulsory to create a frame for this technology so as to simplify it, make it reliable and easy to access.

VAJRA
AQUECIMENTO

ENG. RAFAEL RIBAS, **Founder and co-owner and manager of Vajra. Former Vice-President of Apisolar, responsible for the Solar Thermal Activities. Now member of the APISOLAR Adviser Council.**

What is your feedback on the experience you have with the solar cooling installation at Vajra Offices?

The system has been working since October 2005 and we are very satisfied with it. It simply works without problems with almost no need for servicing. Only the cooling tower with an open cycle needs a monthly surveillance in the hot season for the water quality parameters. The performance in winter is astonishing: as the system was dimensioned for the cooling and therefore presents double area figures for the winter needs, we saw solar fractions of around 80-90% in heating. For the cooling season we saw until last year solar fractions of 51% which corresponds to the simulations done at the Fraunhofer ISE. For the last summer we introduced some upgrades in the circuit controls and mainly an important speed diffuser in an inlet from the heating circuit to the tank to promote better stratification and we saw the fuel consumption reducing to almost to the half.

So in general we can say that this system follows or even exceeds the expectations and shows a trouble free behavior.

According to you, what is the solar cooling potential in Portugal?

There is a big interest in such solutions: everyone hearing about such solar cooling system asks at once for an offer. So the interest and curiosity are there.

But the sensible point is the price: for the actual prices we are not in the economic range. Nevertheless we are better than the photovoltaic's without subsidies, but still the prices had to be cut by half at least.

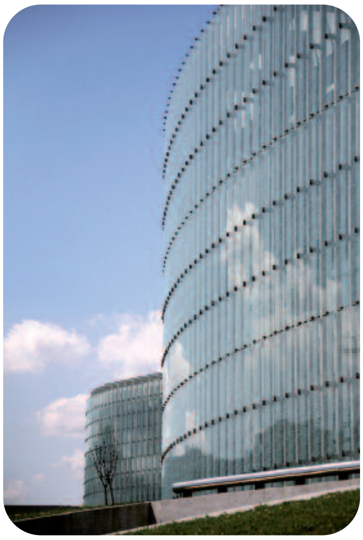
According to you, what is needed in order that solar cooling takes off in Portugal?

Following the conclusion of the last question, It's very clear that one way to boost the solar cooling is with subsidies granted by the government whatever the type.

Furthermore there is of course the technical development to help to find more compact solutions specially in the domestic range to reduce prices.

If there are some subsidies it will help to first start a market and then consequently promote all inherent developments.

I think that there are already enough valid technical offers in the international market which can justify a good starting point for a solar cooling market.



Facts on SAC Systems

Political context

Nowadays, energy situation is characterized by an unstable political situation resulting in many clashes and fluctuating oil and gas prices. Despite some uncertainty, experts agree on the fact that peak oil price has not already been reached. Moreover, future of nuclear energy is not yet clear, due to the lack of convincing technical solutions for the problem of nuclear waste, danger of nuclear disasters and high initial costs. This reality, therefore, makes security of energy supply be in risk.

During the past years, renewable legislations have strongly increased all over Europe. The goals of 20-20-20, the Renewables Directive 2009 and a high amount of national renewable obligations in the residential sector have been published. In many cases, these obligations go in the direction of installing solar thermal systems, e.g. Spain.

Why to promote SAC

Solar cooling is a recent technology which is currently entering the market. This kind of installation is one of the very few sustainable cooling sources which could actively contribute to mitigating summer power demand peaks both at European grid level and especially in isolated grids at limited capacity.

What should be done

A basic consideration is that industries need a clear long-term vision. A good policy agenda should therefore take into account all aspects affecting the solar cooling market. Likewise, it should set clear goals concerning, for example, the number of expected installations within a certain period of time.

TECHNICAL SIDE

Policy makers should think about supporting R&D, the basis for technical development and cost reduction.

Raising technical knowledge is crucial for the development of solar cooling. Training courses, design guidelines, technical information events etc. will help overcome the lack of know-how and create skilled planners. In order to support these last ones in the realisation of solar cooling systems, simplified simulation tools, monitoring systems and “kit devices” are needed.

Taking advantage of the existing Energy Performance Building Directive and the growing demand for polygeneration plants, solar thermal becomes a suitable option not only for heating, but also for cooling and in some cases, dwelling hot water production.

Standards and certification procedures are necessary to assure quality and create official references for planners, installers and plant operators.

ECONOMICS

There are enough arguments to refute the high investment costs of solar cooling installations. The increasing energy prices, for example, will reduce pay-back times in the future. Besides, if externalities of conventional cooling systems are considered, solar energy will be even more convenient. In the other hand, the prices of thermal cooling equipment are decreasing and will keep decreasing in the next years: specific investment costs of solar cooling kits were about 5.000 - 8.000 €/kW in 2007 and are expected to decrease down to 3.000 €/kW in 2010.

Incentives obviously play a vital role: dedicated subsidies are foreseen but these, for the correct development of the market, should tightly be linked to plant’s real efficiency, saved primary energy and to the electrical consumption of cooling equipments.

SOCIAL ASPECTS

Awareness towards solar cooling can be raised in various ways, such as organising promotion campaigns at local level, visits to existing installations or showing success stories among others.

Introducing the guarantee of solar result scheme in solar thermal contracts might strongly contribute to improving confidence in solar cooling. Some countries in Europe already made positive experiences in this regard.

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Edited by Olatz Ajuria, EVE - Ente Vasco de la Energía.

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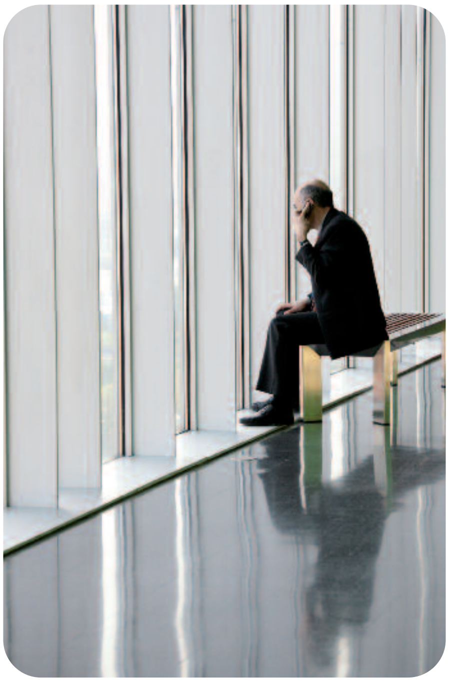

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