solarcombi+

D2.6: SWOT Analysis

Edited by:

Ms Myrto Theofilidi, Dr. Yannis Vougiouklakis

Project Partner ΚΑΠΕ CRES

July 2009

Identification of most promising markets and promotion of standardised system configurations for the market entry of small scale combined solar heating & cooling applications
EIE/07/158/SI2.466793 09/2007 – 02/2010

Intelligent Energy Europe

1 Introduction

This report serves as an assessment of the market for small-scale solar combi plus systems and it is conducted through the identification of their strengths, weaknesses, opportunities and threats (SWOT). The assessment is based on the information collected and the studies produced in the framework of the SC+ project.

A significant part of the project included the examination and evaluation of the European market, not only in regards of the small-scaled chillers, but also considering competing technologies for heating and cooling of buildings. In specific, a market survey conducted on the existing cooling systems summarized and illustrated the current market situation, considering available types of cooling systems, distribution alternatives, installations and sales' shares both in a European as well as national level. Among the available cooling systems, a description of the market characteristics of SC+ chillers was also conducted and focused both on technical data, such as compatibility with distribution systems or most favorable applications. Moreover, a market survey was conducted in relation to the solar thermal installations in Europe, and in particular solar cooling, whereas the survey carried out through questionnaires targeting end users, illustrated their preferences, their views and awareness on renewable energy and efficiency and made it possible to form an overview of the market potential and relevant consumer of SC+.

The market analysis was followed by a study on the manufactured SC+ systems currently available in terms of component cost. This was followed by a complete economic analysis that compared different investment plans (one of which would be SC+) or examined the possibility of replacing an old system by a SC+ one. This economic comparison gave out significant conclusions concerning the technology's economic viability, which are going to be used for the SWOT Analysis that follows. Finally, a statistical method called learning curve analysis provided the required framework in which the examined technology's market has to be developed in order to achieve the desired market penetration.

In the meantime, a number of basic configurations were established and simulated under a variety of different combinations of parameters in regards with location, application collector type, heat rejection technology, hot water storage volume and collector size. Those, which showed up the highest energetic and cost efficiency for a broader range of applications, served as a model for the definition of the standard system configurations.

Taking into account the results of all the above, a SWOT Analysis is carried out distinguishing the arisen conclusions into Strengths, Weaknesses, Opportunities and Threats.

2 SWOT Analysis

The SWOT Analysis is a very common process in strategic planning, providing a framework to categorize a wide range of inputs from technical, financial and other experts in a way that facilitates decision making. SWOT is an acronym for Strengths, Weaknesses, Opportunities and Threats. The SWOT analysis headings provide a good outline for reviewing and assessing the strategy, position and direction of a company or business proposition, or any other idea.

A SWOT analysis is a subjective assessment of data which is organized by the SWOT format into a logical order that helps understanding, presentation, discussion and decision-making. The four dimensions are a useful extension of a basic two heading list of pro's and con's.

Moreover, a scan of the internal and external environment is an important part of the strategic planning process. Environmental factors internal to the investigated product/system usually can be classified as strengths (S) or weaknesses (W), and those external can be classified as opportunities (O) or threats (T).

Figure 1: Schematic representation of the SWOT Analysis

Based on the aforementioned principles, a comprehensive SWOT analysis for the SC+ systems is carried out in the following paragraphs. This analysis aims at recognizing the advantages and the drawbacks of the technology, which are categorized as strengths to be enhanced and weaknesses to overcome respectively. Moreover, external factors related to the current market situation and the prospects for future developments are investigated with the aim of identifying the opportunities to be exploited and the threats that have to be avoided for a successful market penetration of SC+. The investigation of both strengths and weaknesses is conducted on a technical, cost-related and marketing basis, whereas the exploration of external factors, i.e. opportunities and threats, is carried out through consideration of technical, cost-related and market related issues, as well as financial incentives and legislation.

Strengths	Weaknesses
Technical issues Cost-related parameters Marketing	Technical issues Cost-related parameters Marketing
Opportunities	**Threats**
Technical issues Cost-related parameters Financial incentives Market-related parameters Legislation	Technical issues Cost-related parameters Financial incentives Market-related parameters Legislation

Figure 2: Schematic representation of the conducted analysis for the SC+ systems

2.1 Strengths

2.1.1 Technical issues

S1. High electrical COP and high potential for further increase of SC+ system's efficiency

In general, the electrical COP of the best configurations for solar thermal systems as resulting by the simulation analysis ranges from 11 up to 71. With an average electrical COP of app. 30, it is significantly higher than the respective COP of competing technologies (e.g. the average COP of a heat pump accounts for 3 – 3.5, though if geothermal, it can reach 7). Moreover, when analyzing the viability of a SC+ system, it has to be considered that it is currently at a development stage, while R&D is still ongoing. This suggests that technical improvements are bound to take place, as observed through the market deployment of numerous technologies. The potential for an increase in efficiency (electrical COP, Total Solar Fraction) is rather high and will positively affect SC+ systems' technical performance.

S2. Compatibility with conventional heating/cooling & existing distribution systems

An important issue is that it is feasible to connect a SC+ system with conventional heating/cooling systems, such as boiler and heat pumps already installed in a building. Moreover, the compatibility with existing distribution systems such as fancoils and chilled ceiling offers an added value to the technology, taking into account that, in other cases where the installation of a new distribution system is requisite, the effort and expenses could be rather burdening.

S3. Extension of the use of existing ST systems (DHW)

One of the major advantages and motivations for implementing a SC+ system to a residential building is the upgrading of existing solar thermal systems that merely provide DHW to a major building energy provider, in order to cover, additionally, the needs for space heating and cooling.

S4. Best configurations result in high performance operation

As resulted from WP4's definition of standard system configurations, a number of resulting best cases show exceptional performance in terms of efficiency, independent of product. In specific, certain combinations of the semi-fixed values (i.e. collector's type, heat rejection system's type and chilled/water distribution system) lead to very promising results in terms of total solar fraction and electrical COP. That is, independent of specific product (different chillers) and for all of the locations (climatic regions) and applications (type of building) the best performance is met when combining chilled ceiling (as a distribution system) with wet cooling tower (as heat rejection system) and evacuated tube collectors. For these configurations, the total solar fraction ranges from 40 to 87% and the electrical COP from 12 to 70 in residential applications while in office buildings (where only fan coil was considered in the case studies) the total solar fraction ranges from 55 to 97% and the electrical COP from 11 to 24 respectively. If compared to residential building applications, due to negligible DHW loads, the ratio between winter and summer loads increases in office applications. Therefore, the total solar fraction is significantly higher, while the primary energy saved is fully comparable.

Moreover, the best solutions are obtained when the largest collector's area and storage volume are used. In specific, the analysis on standard systems configurations showed that sizes of 5 m^2/kW_{ref} and 75 l/m^2 work best under all considered conditions. Generally speaking, for residential applications best performing plants are encountered where high radiation is coupled with high cooling loads and modest needs for heating and DHW preparation (i.e. high ratio between suitable solar energy and heat demand).

S5. Stand alone systems for covering base cooling loads

In most cases, as proven by the analyses conducted up to now, the SC+ systems is in position to cover the average cooling loads in summer without the need of further committing an auxiliary system. However, this applies mainly to office buildings, where the cooling load period corresponds with the highest irradiation period, and not in domestic buildings, which, furthermore, have a non-negligible requirement for DHW. As resulted from the definition of standard system configurations, the total solar fraction for office applications is significantly higher than the corresponding residential applications for the same climatic regions. For instance, the average total solar fraction of an office application for different configurations reaches 93% in Naples and 81% in Toulouse

S6. Tailor-made systems achieving better performance

The current nature of manufacturing and retailing of SC+ systems allows for a customization according to specific needs and application/region specifications. Such a provision is advantageous for the end-user as he can profit by a better performance.

S7. Improvement of storage capabilities of SC+ systems

As mentioned also previously the current market phase of the examined technology is characterized by ongoing R&D, which allows for a further improvement of the storage capabilities for SC+ systems. Such an improvement would be a key feature, as the SC+ would be able to also cover night cooling loads and would become especially attractive for domestic applications at Southern climates.

S8. Future development of standard design systems

Being one of the main goals of the project, the identification and development of standard design systems will contribute to achieving a highly intensive market deployment, by reducing significantly the design effort for single applications and providing the manufacturers the required information and means for the development of package solutions. In this way, the SC+ system can be promoted and applied in a similar way as the standardized systems for domestic hot water production, which work practically well in common applications and are independent of specific product.

S9. Less losses of transformation from PE to electricity

A technical parameter that should also be considered is the reduction in losses occurred during the transformation of primary energy to electricity, taking place for the operation of other technologies. Solar thermal systems due to the fact that they mainly use thermal energy achieve significant reduction of primary energy conversion losses.

S10. New applications emerging

Due to today's developing stage of the examined technology, in terms of R&D, new applications are emerging, different than the ones considered so far, allowing for the consideration of innovative ideas and alternative solutions. For instance, it is currently attempted to apply the technology in ships for cooling, where the excess heat of ship engines would be used as supplement or instead of solar irradiation. The chillers will become widely known, even if applied at different circumstances, letting end users become familiar with small scaled chillers and later consider the installation of SC+ systems.

2.1.2 Cost-related parameters

S11. Relatively low operating cost (in off-gas mode: eg, cooling)

One of the main issues that have to be investigated in any developing technology is its economic viability. The most significant parameter for examining it - besides the initial investment - is the operating cost. Renewable energy technologies have the advantage of minimizing the operating cost, which mostly consists of the energy (fuel or electricity) cost. Therefore, one significant parameter of the SC+ systems can be found under the low operating cost when it is operated in off-gas mode. According to the economic analysis conducted in D2.4, the operation of SC+ can reach a reduction of operating cost (when compared to competing systems) from 80 to 95%. This is translated to the period that the irradiation is significantly high and the demand is not exceeding the capacity of the system, so that the heating/cooling needs can be covered solely by the operation of the SC+ system. On the other hand, it is obvious that an auxiliary system has to be implemented during the periods that either the irradiation is low or the loads exceed by far the capacity of the system. However, the yearly usage of the auxiliary system and, subsequently, the yearly energy consumption is much more restricted than that of a conventional system. The latter was also practically proven through the economic analysis conducted in phase 1 of WP2.

S12. Almost independent of energy markets

The operating cost consisting mostly of fuel/electricity cost is a major issue affecting consumers' preferences. Furthermore, today's volatile energy markets make it quite impossible for the consumer to predict or estimate the fluctuation of energy prices on a long-term basis. Therefore the technology's independence from energy markets can be effectively used for its market promotion.

2.1.3 Marketing

S13. Relatively good cost of primary energy saved

The cost of primary energy saved is a reliable indicator for the energetic and economical efficiency of the examined technology, being a global measure of the convenience to substitute conventional primary sources.

According to the report on the standard system configurations, the cost of PES distribution ranges from 0.08 to 0.68 €/saved kWh, with an average of 0.33 €/saved kWh. The cost of PES is calculated by the following formula:

$$C_{PEsaved} = \frac{C_{SC+} - C_{conv}}{PE_{saved}}$$

where C_{SC+} : cost of initial investment (purchase, planning, installation) plus O&M costs (for 20 years) of SC+ system (€)

C_{conv} : cost of initial investment (purchase, planning, installation) plus O&M costs (for 20 years) of the conventional system (€)

PE_{saved} : primary energy saved by using the SC+ technology (kWh)

This means that a negative value of cost for PES would be twice as profitable, meaning that not only does the SC+ system save energy but it is also a more economic solution than choosing a conventional system. On the other hand, as the cost of PES increases, the "price" for saving primary energy becomes higher.

However, the average cost of PES that lies around 0.1 – 0.2 €/kWh can be considered relatively low for the benefits achieved from a global point of view and can be therefore become a promoting material for the examined technology. Moreover, it is expected that the cost of PES will decrease significantly in the future with the rise of primary energy prices and the improved manufacturing processes.

S14. 3-in-1 features: One product solves 3 needs for the user

Marketing may be substantial for the viability of a new technology, which can be successfully promoted if the right aspects are selected. In the case of small-scaled SC+ systems the major marketing-oriented advantage is found under the bundling of multiple functions into one single product. In specific, the user or operator of such a system will profit by covering all his three energy requirements (i.e. heating, cooling and domestic hot water) through only installing one system.

S15. Positive environmental profile – Mitigation of CO_2 emissions

A second advantage that can be widely employed as a promotion tool is the environmental profile being developed by the operation of a solar thermal system, in terms of CO2 emissions reduction, saving of primary energy and electricity. The analysis conducted on the simulation results provided the outcome that, in absolute terms, the avoided CO2 emissions range between 2 and 4 tons/year in all case studies. If one bears in mind that the residential building considered could be used by a 4 people family (0.5 to 1 tons CO2 spared each) and that in a typical European city every inhabitant is responsible for around 8 to 10 tons of CO2 emitted per year (transport and economical activities also considered), it can be extracted that the large scale diffusion of SC+ systems would lead to a significant reduction of the CO2 emissions and therefore of the primary energy used. The aforementioned conclusion could be also essential for the promotion of SC+ systems. Particularly when installed in offices, owners/organizations can benefit by its advertising, exhibiting their environmental concerns, through the beneficial results achieved, such as reduction of CO2 emissions and the primary energy savings.

S16. State of art equipment / system

Above all, the SC+ systems are considered to be a state of the art and innovation-based technology. One of the SC+ systems participating in the project has been awarded with a number of distinctions, being also a patented technology. Moreover, the good reputation achieved through further recognitions and awards of both the technology and the management team can significantly strengthen the market position. This could be extended to the rest of the systems as they all share similar principles based on adsorption or absorption chillers. The SC+ technology could be therefore in general promoted as an award winning promising technology.

S17. Production plants location

Certain production plants of SC+ systems are geographically positioned in strategic areas of Europe, in terms of both being able to serve adequately the EU market and taking advantage of the available labor capacity of the region. Strategic position means reduction of transportation costs, higher chances for commercialization and becoming widely known

S18. Existing installation as best practices

For marketing purposes, the already installed SC+ systems may play a significant role in various ways. Apart from just serving as best practices and verifying the gained approval from the consumers' side, they can also indicate the most preferred locations and applications, but also become an inspiration and driving force for relevant consumers.

The participating industrial partners of the SC+ project, sharing their sales/installations history, declared that they have installed approximately 200 SC+ systems until the end of 2008. Figure 3 represents the shares of installations in each country. Spain holds the vast majority (53.5%) and it is followed by Germany, Austria and Italy with shares of 15.5%, 11% and 9% respectively. Some single systems have been installed in other European countries, such as France, Belgium, UK, Switzerland, Sweden and Hungary while others have been installed to countries outside the EU, namely UAE, USA and China.

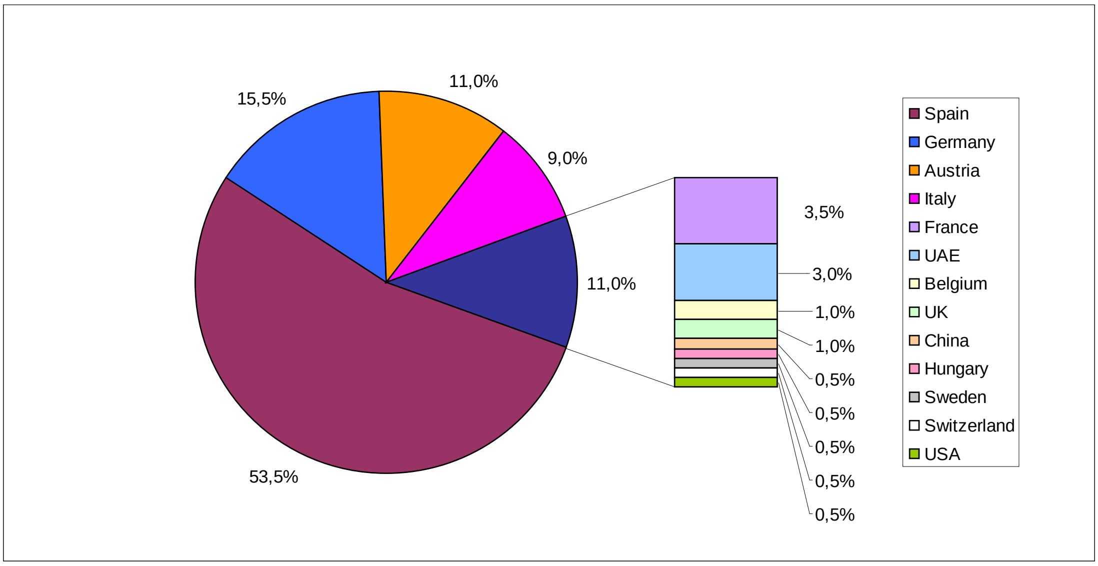

Figure 3: Existing installations by country

Moreover, Figure 4 illustrates the installations in terms of application. Obvious is the preference to office buildings which hold 39.5% for private offices and 2.5% for public buildings. The residential installations for domestic use also hold a significant share with 26.5% of the total installations. Moreover, there have been a number of installations to laboratories, schools, a retirement home, a camping, a medical utility, a sports centre and a university.

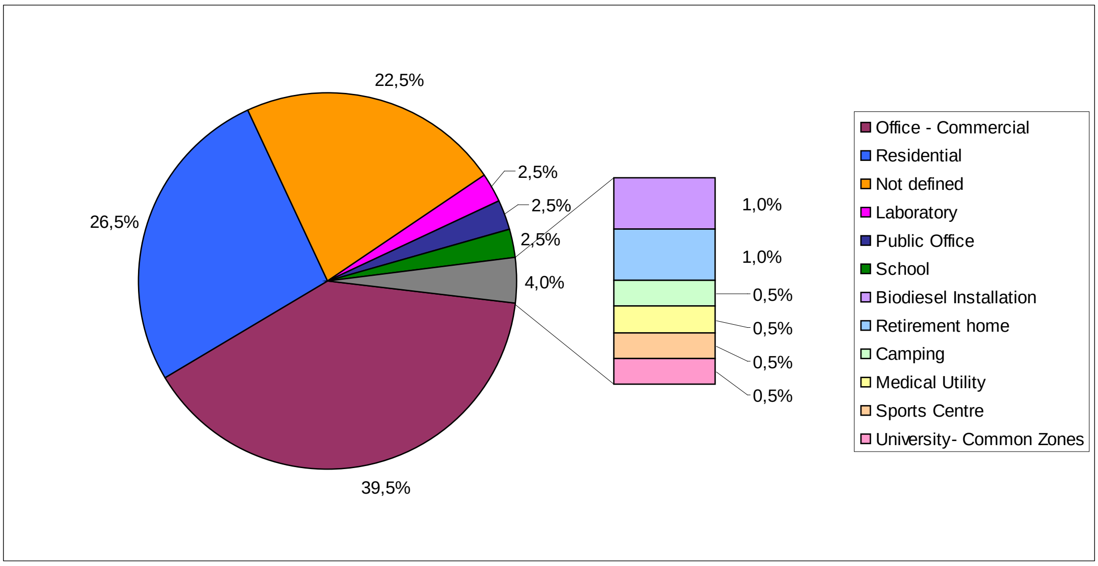

Figure 4: Existing installations by application

2.2 Weaknesses

2.2.1 Technical issues

W1. Storage required

One of the drawbacks of the investigated technology is the requirement on storage for hot water and partially cold water as well. In specific, hot water has to be stored for the hours of the day with no irradiation as well as for low irradiation periods during the year.

W2. Large unoccupied area required

A major issue that can become a barrier for the further development of the market for small scale SC+ systems is the requirement on relatively large unoccupied area. Since the main targets of this technology are single-family houses and small office buildings, it is rather difficult to rely on the fact that such an area will be available.

W3. An auxiliary system required

Probably the main technical drawback of SC+ systems is the fact that they cannot stand alone. As proved through the previous economic analysis, as well as the simulations carried out on various case studies, the SC+ systems are almost always dependent of an auxiliary system, at least for heating and DHW, a fact that reduces the potential for targeting a wider applications area.

Moreover, as concluded through the identification of standard system configurations, in some cases the electricity consumption is rather high, resulting into low total electric efficiency. This applies mainly to the cases of office applications, where the cooling loads are significantly high and, on the other hand, fan coils are implemented as a suitable distribution system.

W4. Not efficient for all different combinations of location/application

As arisen by the analysis of the virtual cases simulations and the later definition of standard system configurations, the SC+ systems are not efficiently applicable to all combinations of location and application. Some of the best configurations showed somewhat poorer performance in regards with electrical COP. For instance, the average electrical COP of office applications in Naples and Toulouse is 11.5 and 15.9 respectively, which is rather low in comparison with the more promising residential applications reaching the efficiency of 50.

W5. Not standardized and available off-the-shelf yet

Currently the SC+ systems are tailored according to specific needs and no system has yet been developed to be applicable to a series of varying circumstances and requirements. This is also the reason for the high complexity of hydraulics and control of the system, which raises the probability of installation errors or failures during the operation. Moreover, the results of the definition of standard system configurations proved that solutions close to the best ones are not completely product independent when different technologies or component sizes are considered.

2.2.2 Cost-related parameters

W6. High capital cost

As discussed thoroughly in the analysis conducted so far (see Deliverables D2.1-2.5), the SC+ systems are still in a development phase with R&D still playing an important role in the future prospects of the technology and the manufacturing process being based on tailored specifications. A by-consequence of this early market development phase is the rise of manufacturing cost followed by a significant increase in the capital cost, which makes the purchase of such a system very expensive for an initial investment when subsidies are not available. The high capital cost can be, therefore, considered as one of the most significant weaknesses of the examined technology.

W7. Non-negligible operating cost

As mentioned earlier, an auxiliary system is almost always necessary for the operation of a SC+ system and for a reliable coverage of all three provided utilities. This suggests that some extra fuel cost has to be considered. Moreover, electricity is consumed for the operation of pumps. The sum of the aforementioned costs for the course of the year, as resulted by the previous analyses, cannot be neglected although significantly lower than conventional heating/cooling systems. However, it fails to be quickly depreciated and exploit the main advantage of renewable energy technologies, namely the minimization of operating cost.

W8. No economies of scale

At the moment the production of SC+ is at a very early stage, whereas production plants are barely initiating their operation, a fact that hinders the instant reduction of the long-run average costs of production. This uncertain market in terms of manufacturing cost for SC+ is a significant barrier for the establishment of economies of scale, which would make the technology widely known and applicable.

W9. Relatively high installation and transportation cost

At the moment the systems manufactured at the production plant are distributed to retailers and shifted to the installation site. The lack of local retailers raises the cost for transportation, since at certain cases the systems have to be transported even to different countries. Moreover, since the technology has not been widely approved and developed, no investments have been taken place in terms of training towards both engineers and installers on a local level, a fact that also contributes to an increase of installation cost.

W10.Relatively high maintenance cost

The lack of local retailers also affects issues concerning maintenance. The maintenance cost rises due to lack both of trained on-site personnel, as mentioned previously, as well as procedures like the replacement of parts, which also includes their transportation from distant retailers. In addition to the cost-related drawback for the maintenance of the system, the time frame necessary to conduct the maintaining has to be considered. That is, in case of an unexpected dropout of the system, the period required for the maintenance procedures to be organized and/or the personnel to be shifted onto the site might be longer than expected.

2.2.3 Marketing

W11. Limited operating experience - No reviews and testimonials of existing installations yet

In terms of marketing, a distinguishing weakness is recognized through the lack of operating experience. Although, as already mentioned, there are approximately 200 systems already installed in different locations worldwide (96% of which are inside Europe), the operating period is not long enough for extracting safe conclusions on the system's reliability to become well-known and market-established. Moreover, there has not been any official study yet on their reliability and their achieved performance, based on the owners/operators' experiences. That is, no testimonials have been documented and no official survey has been carried out regarding the customer's/user's satisfaction and the coverage of specific needs. However, the manufacturers/providers of SC+ systems, participating in the project, individually contact their final customers, examining their satisfaction with the operation of the system.

W12. Lack of local retailers

As mentioned previously (see W9, W10), the lack of local retailers, which sometimes even accounts for no presence at all in certain nation-wide markets, is apart from the cost-related issues a major hinder for the successful promotion and market entry of SC+ systems in certain countries.

W13. Limited market applications

Although the machines can be installed in parallel to reach high cooling loads, the fact that the examined technology concerns systems that do not exceed a cooling capacity of 20kW could be a marketing obstacle, since it only explicitly addresses a limited number of applications in the relevant market.

W14. Aesthetics

An area that could be unattractive for the SC+ system's successful promotion is its visual impact. In specific, the large required area for the solar collectors' installation might raise controversial discussions and negative views for instance, among architects in the design phase of a new building.

W15. Lack of user friendly interface and automated features

Since the examined technology is fairly new, most of the effort is laid on the sectors of R&D for the improvement of technical characteristics and the efficiency itself, in order to become robust and competitive. The external characteristics are given currently less attention, the technology being therefore less user-friendly and automated in comparison to competing technologies, such as air-conditioning systems (no features such as smart switch on/off or timer)

W16. Non-adequately trained technical personnel

Due to the limited market presence of the SC+ systems and the ongoing development of conditions for a successful market entry, there has been no specified training program currently established. That is, the engineers and installers are not thoroughly aware of the varying design parameters and there are no significant provisions of technical support in a local level. Effort is currently given through various IEE projects to enhance the training of specific interested parties, but, nevertheless, there is no ongoing mechanism for the continuous training of the respective technical personnel.

W17. No trademarks currently in force

Although one of the examined SC+ systems already owns a trademark, this does not apply to all systems, which is a consequence of the early market stage of the examined technology. From a marketing point of view, established trademarks would reassure on the technology's consistency providing significant recognition by the potential clients' side.

2.3 Opportunities

2.3.1 Technical issues

O1. Locations with good solar irradiation - high cooling loads - high fuel prices

In Europe there are sufficient locations with good solar irradiation (such as the Mediterranean countries) that can be exploited for the development of various technologies using solar energy, among which is also the SC+ systems. Besides, high solar irradiation is usually accompanied by higher temperatures and subsequently growing cooling needs, i.e. a cooling system using solar energy could be fairly efficient for such locations. Moreover, such a technology could compensate the increasing level of fuel and electricity prices that characterize many European countries.

O2. Isolated buildings/regions

The solar technology can be efficiently applied in isolated buildings or regions where the infrastructure does not meet the energy requirements. That is, buildings and regions that are not interconnected to the electricity or natural gas grid or where the transport of oil is carried out with difficulties may profit by installing a SC+ system to achieve energy sufficiency. As already mentioned, a SC+ system can adequately cover the base cooling load without an auxiliary system using fossil fuels, whereas the electricity for the operation of the pumps as well as the coverage of heating and peak cooling load can be completed by relevant renewable energy technologies.

O3. No significant future improvement of fossil-fuel technologies foreseen (efficiency)

A fact that can be used as an opportunity for a more intensive market entry of SC+ systems is the competing technologies' fading prospects in terms of performance. As most of fossil-fueled technologies for heating and cooling have been adequately employed into the market for several years, the right conditions were created for a continuing R&D and implementation of improvements in efficiency, performance and applications. However, as statistically observed, no significant future improvement can be foreseen, as, usually, after having reached a peak, it is rather unlikely to invest on research for an old technology.

O4. Future building integration

Until today, SC+ systems are installed to an existing building, probably even replacing an older heating/cooling system. However, a future ambition, connected to the trends for buildings design and construction procedures, is to integrate the system in the building's planning, so that it can be effectively designed, through the early identification and avoidance of possible technical difficulties or even customization of the building to naturally incorporate the solar system.

O5. Standardization

As for all evolving technologies the standardization is a significant step for a mass market deployment, as the production moves from single customized designs to a standard large-scale level. According to surveys, standards impact 80 percent of world commodity trade being a measure for reliability and success. They furthermore improve competitiveness in global markets and achieve consistent quality, and safety.

O6. Improvement of manufacturing technologies

The technological advancements globally will play a significant role in the improvement of manufacturing technologies, in terms of efficiency, automation and control, which can also be utilized in the SC+ production.

2.3.2 Cost related parameters

O7. Increase in fuel prices

A major opportunity of a renewable energy technology, such as SC+, is the increase in fuel prices. In fact, the minimization of fuel dependency is gaining growing importance in the current energy markets, while fossil fuels and electricity prices are characterized by a constantly increasing tendency. The SC+ systems are not fully independent of fuels (auxiliary system and electricity-driven pumps); however their fuel/electricity consumption is significantly lower than any conventional technology (see S11). An increase therefore of the fuel/electricity price would definitely be in favour of SC+ systems.

O8. Cheaper than electric-driven compression chillers

One of the most prominent competitions for SC+ systems is the electric-driven compression chillers. In comparison to them, solar thermal chillers might be cheaper (in terms of operating cost) when the electric infrastructure of a region is not sufficient for electric-driven ones, especially during periods with high electricity demand. For instance, forecasts indicate that in Austria the demand for cooling will rise from 2% today up to 25% in 2025. This might cause electricity infrastructure problems which make SC+ systems more attractive even with a higher installation cost.

2.3.3 Financial incentives

O9. Available financial incentives per country (ask partners)

The availability of financial incentives for the installation of solar thermal systems signifies a very important opportunity for the market promotion of small scaled SC+ systems. It provides a powerful motivation and according to the height and the conditions of each incentive may be the driving force for a successful market deployment. In the following, specific incentives applied to the participated countries are presented and described.

<u>Germany (source: ISE Fraunhofer)</u>

1. The driving mechanism for funding the installation of new solar thermal systems is the **market incentive program of BAFA**: The

Federal Office of Economics and Export Control (Bundesamt for Wirtschaft und Ausfuhrkontrolle – BAFA) has funding mechanisms for renewable energies, including solar thermal systems: 175 million Euro budget funds have been made available in 2007 (2006: 142 million Euro) for solar thermal, biomass and geothermal applications. The BAFA funding refers to basic investment grants and the funding mechanism is implemented under the following conditions:

- Collector gross area ≤ 40m²
- For solar domestic hot water preparation only: 60 €/m²; minimum 410,- € total;
- For other applications (heating support, solar cooling, process heat, etc.): 105 €/m²
- Funding is applicable after installation and start of operation
- Collectors must have at least 525 kWh/m² output at a solar fraction of 40% (based on a defined calculation routine for low temperature domestic hot water demand profile), and must be certified according to DIN EN 12975 and need the Solar Keymark Version 8.00 certificate.

Additional funding is possible for special issues of the installation, such as the parallel exchange of the gas boiler to a high efficient one, for high efficient buildings, for the installation of high efficient pumps, for innovative approaches, etc.

The basic funding is reduced by 20% for applications, which meet the area of validity of the EEWärmeG (new buidings).

2. For larger systems, funding is possible through the **German Reconstruction Loan Corporation (Kreditanstalt für Wiederaufbau - KfW)**, included into the BAFA-program.

- Application for investment grant before installation
- Collector gross area > 40 m²: 30% of eligible costs refundable
- Required information: detailed offer, detailed hydraulic system scheme, comprehensible statement on expected specific collector output and solar fraction, design data sheet.

A ‘budget traffic light’ informs about the status of available resources for funding. Information at:

References:
www.bafa.de/bafa/de/energie/erneuerbare_energien/index.htm

Italy (source: EURAC)

The **Law no.244** of 24 December 2007 valid until 2010 regulates the incentives for the installation of solar thermal systems for DHW production.

In detail, they are income-tax deductions of 55% of the first cost applicable on personal income tax withholdings or, in case of private company, on corporate income tax. The maximum limit of these incentives is 30.000 € – i.e. 55% of 54.545,45 € - and they could be arranged by a maximum of 10 installations.

This income-tax deduction (of 55%) is not combinable with other incentives and/or deductions granted for the same purpose.

France (source: TECSOL)

1 Private installations:

1.1 A **tax credit** (or a grant for those who pay or do not pay taxes) exists for **private solar thermal installations**. Since 2006 this amount is 50% of the equipment's cost for solar thermal installations with a limit of expenditure of 8000€ for a single person, and 16000€ for a couple. More grants may be obtained from local authorities (ex: generally between 200€ and 500€ per system).

Moreover, the national agency ANAH and the Territorial Communities at different scales (Regions, Departments, Communes) could give a **financial bonus** to the people who want to **install a solar thermal system** (and more generally people who want to install a system that uses renewable energy).

References: http://www.anah.fr/

1.2 In France, the ground occupancy coefficient (COS) specifies the surface that can be built in function of the estate size. The urbanism rules especially the local urbanism guidelines can define the COS value applied to an estate. The **decree of May 03, 2007** offers the possibility to **overrun this limit by 20%.** This possibility is offered to the buildings which are considered like "very high energy efficiency, renewable energy and heat pump, THPE ENR 2005" or "Low consumption building, BBC 2005", or even buildings that have numerous conditions relating to their energy consumption.

Furthermore, these **labels** (HPE 2005 ; HPE ENR 2005 ; THPE 2005 ; THPE ENR 2005 ; BBC 2005) are a way to give an additional added value to the buildings. And it permits to increase the amount of subventions, or to increase the rent.

References: http://enr.cstb.fr/webzine/preview.asp?id_une=9

2 Professional or public installations:

Grants from the national energy agency (ADEME) and the regional authorities may be obtained, highly varying according to the "Regions", administrative areas. For example, in Languedoc Roussillon (South of France), the amounts are the following:

Collective housing:

- 70% maximum for the study
- 1€/kWh/year limited to 70% of the total investment in the public sector and 50% in the private sector.
- 70% for the monitoring equipment (up to 4000€ maximum).

Social housing:

- 70% maximum for the study
- 1,60€/kWh/year limited to 80% of the of the total investment.
- 70% for the monitoring equipment (up to 4000€ maximum).

Greece (source: CRES)

1 Tax deduction (Law 3522/06)

Within the law 3522/06, an article refers to a 20% tax deduction for a series of equipment including off-grid RES systems, thermal solar heating & natural gas systems, thermal insulation retrofits with a maximum absolute deduction of 700€, mainly targeting to private individuals for the installation of such systems in the household sector.

2 Prerequisite for PV (roof) building installation

An indirect incentive for installing and operating a solar thermal system can be found under the recently issued Joint Ministerial Degree "Special Program for photovoltaic systems development in the building sector and in specific on buildings' roofs". In particular, one of the prerequisites for being incorporated to the program is that part of the thermal needs for DHW of the building (if residential) has to be covered by solar thermal systems.

3 Green Entrepreneurship programs

A new cluster of programs under the Operational Program for Competitiveness and Entrepreneurship, targeting to promote the concept of "green" enterprises was launched in May 2009. These programs, belonging to the "Green Infrastructure", "Green Enterprise" and "Relocation" respectively, aim to promote the concept of the green entrepreneurship and facilitate the development of such business plans.

The overall budget of these programs is 136M€ (60, 60 and 16 respectively) with the public support of 68M€ to relate with grants of 30-60% per project. The actions that will be funded within these programs include among others the reduction of the environmental and energy footprint of the enterprises, the development of new “greener” services and products, energy and water savings installations, recycling and reuse of waste, waste management and in general the adoption of environmentally friendlier structures and mechanisms within the eligible to participate enterprises. The first round of applications, including the evaluation, is expected to be concluded by the end of November 2009.

Austria (source: AEE INTEC)

The installations of solar thermal systems are supported with **direct-subsidies by the corresponding provinces**. Depending on the type of the building each province has its own specifications. For instance, the subsidy for a 15 m² solarcombi system for a detached house amounts in Lower Austria 3,480 € and in Styria 1,250€. Additionally to the province-subsidies, **some communities** are supporting solar thermal systems monetary from 15 €/m² to 200 €/m² collector field size. The requirements for the incentives range from a minimum collector size over diverse quality standards to a compulsory for the installation of heat meters.

Within the public subsidies for residential buildings, the installation of a solar thermal system has a positive influence on the annuity and interest grant as well as on the credit performance. However the public subsidies for residential buildings can be combined with the direct subsidy for solar thermal systems only in certain provinces. This means that there is a relatively large bandwidth on the level of financial incentives.

References: http://www.solarwaerme.at/Geschosswohnbau/Foerderungen/

The so-called “**Agreement according to Art.15a B-VG**” is signed between the federal government and provincial governments. This agreement prescribes an installation of a solar thermal system, in case the boiler of the heating system is driven with fossil fuels, to come to the monetary benefit of the public subsidies for residential buildings.

An additional promotion for solar thermal systems was done with the so called “**refurbishment-check**” in April 2009. With that check, the installation of a solar thermal system could be declared as a refurbishment measure, which means that an additional subsidy could be obtained. For this refurbishment-check fifty million Euros were made available.

Although no subsidies are available for commercial buildings from the province governments, there is a **federal-subsidy** with a maximum amount of thirty percent of the installation costs. The submission for this financial incentive at "Kommunalkredit Consulting Ges.m.b.H" has to be completed before starting the construction of the solar thermal system.

Finally, the financial disbursement for installing a solar thermal system can be fiscally compensated with the special expenditure for refurbishment. In this case 300 € can be realized.

Spain (source: Ikerlan)

1. **Agreement IDAE-EVE** in 2009 to promote renewable energies

In the Basque Country an agreement between IDAE (Instituto para la Diversificación y el Ahorro de Energía www.idae.es) and EVE (ente Vasco de la Energia www.eve.es) for 2009 is based on the framework to promote renewable energies.

The priority areas are:

- Low temperature Solar Thermal installations, with flat plate collector (FP) or evacuated tubes (ET), for air conditioning, swimming-pool heating, hot water for industrial processes, up to 150 m2 of useful collector area (out from the required according to the regulation CTE Code).
- Isolated solar photovoltaic installation, up to 20kWp and, up to 5kW of wind energy.
- Biomass installations for thermal energy production, for domestic or industrial applications, connected to air conditioning or heating hydraulic system, up to 20 kWt.

The incentives for these installations are up to a 40% of the total eligible cost and they are compatible with other subsidies, always limited to a 40% of the total cost. The maximum amount of money is 100.000€ for the same beneficiary.

2. In the Renewable Energy Strategic Plan "PER" (Plan Estratégico de Renovables) for the next years there are some measures in order to improve and promote the use of renewable energy (see annex II, the section related with solar thermal energy). The current Renewable Energy Plan, in effect from 2005 to 2010, was approved by the Council of Ministers on 26 August 2005.

O10. Prospects for financial incentives (current preparation – discussion on upcoming legislation)

From the participating countries, it is only in France, where a funding scheme for solar thermal installations is being currently discussed and prepared.

France (source: TECSOL)

A new system called Heat Fund (Fonds chaleur) is currently being established; the possible grants are not yet definitively stated but the next two tables give an idea of these future measures. To receive this grant, it is imposed a minimum productivity, a maximum cost per m², and a minimum of 25m² of solar panels.

The amount of grant is detailed in the tables and is limited to 70% of the total cost. The project respecting the criteria will benefit a greater amount than the previous grant.

	Useful solar production in TEP/year				
Collective housing	≤ 3.5 TEP ≤40.7 MWh/an	≤ 12.5 TEP ≤ 145.4 MWh/an	≤ 25 TEP ≤ 290.7 MWh/an	Useful solar minimum productivity [kWh useful / m^2.year]	Minimum ratio on investment [€/kWh useful]
LC	Aide en €/TEP solaire utile produite annuellement				
North	19 000	17 000	16 000	> 350	< 2.50
South	17 000	15 000	14 000	> 400	< 2.25
Mediterranean	16 000	14 000	13 000	> 450	< 2.00

	Useful solar production in TEP/year				
Tertiary building	≤ 2.0 TEP ≤ 23.2 MWh/an	≤ 4.0 TEP ≤ 46.5 MWh/an	≤ 8.0 TEP ≤ 93.0 MWh/an	Useful solar minimum productivity [kWh useful / m^2.year]	Minimum ratio on investment [€/kWh useful]
T	Aide en €/TEP solaire utile produite annuellement				
North	19 000	17 000	15 000	> 350	< 2.50
South	16 500	14 500	12 500	> 400	< 2.25
Mediterranean	15 500	13 500	11 500	> 450	< 2.00

In regards with Solar Air Conditioning, a project of a **grant based on the Heat fund system** is being discussed and should be officially announced in June 2009. Once again, a number of criteria have to be respected.

The eligible chilling capacity has to be in the range 5-200kW. The electrical COP (ratio between useful solar energy (cooling + heating) / parasitic electrical energy used by the system) of the installation has to reach 5 as a minimum (average on a yearly basis, heating and cooling mode) controlled by monitoring.

Secondly, a minimum performance has to be reached: 350kWh/m²/year (sum of useful heating solar energy and solar cooling energy multiplied by a factor 0.6 (sorption chiller COP)).

The grant is calculated on global over cost of the system on 5 years:

Investment - savings + operation & maintenance costs

The maximum grant is stated (to respect the EU maximum grant levels) as following: 60% on large companies, 70% on small and medium companies and 80% on public structures.

The grant will be delivered in 3 phases:

- 50% when the grant contract is signed by ADEME
- 30% after successful commissioning of the system
- 20% after 2 year monitoring and respect of the minimum performance criteria.

O11. Proposal for green tax package

In the framework of the Second Strategic Energy Review issued by the European Commission a proposal for a Green Tax Package is presented as a complement to the energy and climate change package. It should propose a review of the Energy Tax Directive to make it fully compatible with the energy and climate change goals and examine how VAT and other fiscal instruments can be used to promote energy efficiency. The opening of different renewable energy technologies such as the SC+ market could significantly profit by this development.

2.3.4 Market related parameters

O12. Large labor pool available due to recession

A currently important opportunity for the market penetration of SC+ systems is the recent increase of labor pool due to the economic recession. The availability of labor pool will enhance/strengthen the development of manufacturing companies in all the relevant fields of the production procedure, from design to retailing and promotion.

O13. Opening of jobs, businesses, companies - companies - New geographic markets emerging outside the EU

The further development of SC+ market will be accompanied by a significant opening of new jobs and positions, as well as the establishment of new business and retailing companies. Moreover, exporting SC+ systems to third countries will additionally enhance the economy around this technology, which is a major opportunity to be taken advantage of. As mentioned previously, there have been some installations of SC+ systems also outside the EU with a share of 4%. This already shows an emerging interest from different geographic markets on new technologies, especially those of using renewable energies and it could be an essential opportunity for the reinforcement of the market conditions.

O14. Promotion of sustainability (e.g. UN Climate Change Conference 2009)

In the general energy policy of the European Union, sustainability holds an important role in the priorities set for the achievement of its environmental goals. The constant promotion of sustainability through incentives, communications, guidelines and various projects is affecting considerably the market, leading it to an intensive implementation of environmental-friendlier technologies. Through this change of market direction, SC+ technology can significantly profit highlighting its environmental profile.

O15. "Pioneers" and "front runners" both in green technology and environment protection are looking to invest and buy new technology.

The aforementioned energy policies influence various market stakeholders, who are considered pioneers and front runners in fields such as green technology and climate protection. The SC+ technology may be considered ideal for them, as it combines innovation with an environmental and sustainable profile, making them dominant targets for the market development.

O16. Target specific user's profile

An important opportunity for SC+ technology is to focus its market opening towards specific user's profile, where it would have the highest possibilities for wider approval. In specific, applications such as office buildings could profit a lot from installing such a system as it corresponds directly to their specific needs. That is, the heating and cooling load period is normally during the office hours, namely, during the sun irradiation period. Moreover, an office building could save much by not committing an auxiliary system in the summer time, as no demand for DHW is normally foreseen.

2.3.5 Legislation

O17. EU (or national) -Legislation (particularly public sector) for the employment of RES

A major opportunity for small-scaled SC+ systems applies to the enactment of a legislative framework concerning energy efficiency as well as the employment of renewable energy sources in certain fields (particularly buildings) of the private and public sector. The current as well as developing legislation in the participating countries will be thoroughly presented in the following paragraphs.

<u>Germany (source: ISE Fraunhofer)</u>

Since January 2009, a new regulation on the use of renewable energy for heating has come into force. The regulation is valid for new buildings only and it is called: **Erneuerbare-Energien-Wärmegesetz - EEWärmeG**. Its objective is to increase the share of renewable energy sources for space heating to 14% by the year 2020.

According to the regulation certain obligations are legislated:

- use of solar thermal heat for residential buildings with 1 or 2 apartments: minimum of 0.04 m² collector area per m² floor area (only Solar Keymark certified collectors)
- use of solar thermal heat for residential buildings with more than 2 appartments: minimum of 0.03 m² collector area per m² floor area (only Solar Keymark certified collectors)

or

- use of gaseous biomass: minimum 30% coverage of annual heat demand

or

- use of liquid or solid biomass or environmental heat (e.g., heat pumps): minimum 50% coverage of annual heat demand

No measures are necessary, if the building heat demand is covered by at least 50% from combined heat and power production, or if the building is connected to a district heating network, or if the building heating demand is 15% below the actual valid energy saving ordinance (ENEV). The allowed heat consumption in buildings (residential and non-residential) is outlined in the ENEV; the requirements will be increased in 2009 and for another step in 2012.

<u>Italy (source: EURAC)</u>

The **Legislative Decree no.192 of 19 August 2005** and the **Legislative Decree no.311 of 29 December 2006** oblige new buildings and thermal systems which are going to be replaced to cover at least the **50% of yearly DHW** demand by renewable energy sources. For historical buildings, the limit is reduced to 20%.

France (source: TECSOL)

Thermal Regulation 2005 (Reglementation Thermique 2005) directly replaces Thermal Regulation 2000, introducing more severe regulations of **thermal insulation and heating systems**. TR 2005 extends the scope of TR 2000's regulation to include the following:

- Calculated consumption will be limited by an absolute, rather than project-related, value.
- Calculation methodology now includes values for implantation and orientation to better take into account building's external climate. Calculations now include natural lighting and renewable energy sources, and the reference project now uses solar thermal for the domestic hot water supply.
- Imposition of distinct summer and winter requirements to encourage bio climatic architecture.
- Calculation of conventional air-conditioning systems in the buildings to discourage their use and construction in France.

Between 2005 and 2010, TR 2005 will promote the end of thermal bridges; condensing boilers and heating do conduct efficiency feasibility studies before starting construction on many new buildings.

References: http://www.iea.org/

http://www.actu-environnement.com/

Besides, an "**energy economy certificate**" was created by the State on July 13, 2005, and **promotes the energy savings**. The principle is to impose to some actors (energy producers or distributors like EDF or GDF) to save energy, and to encourage the others actors to save energy, and so, they obtain a certificate. The "obliged" actors have two choices: either they make this economy by themselves, or they buy certificates to the other actors. If this energy saved is not achieved by the obliged actors, they have to pay 0.02€ for each "kWh updated accumulated" which is not economically interesting. To ask for a certificate, the minimal amount of energy economized is 1 000 000 kWh updated accumulated. The non-obliged actors can get together to attain this amount, and to sell their certificate. Thus, this measure encourages saving of energy in all the sectors.

References: http://www.industrie.gouv.fr/energie/developp/econo/cee-clics.htm

Another **decree** made on **March 21, 2007** imposes to almost all buildings a **minimum temperature of 26°C** inside the building to be allowed to switch on the air conditioning.

This **TR2005** defines 3 geographic zones (H1, H2 and H3). For each of these zones, a maximum consumption is stated for heating and hot water with fossil fuel and electricity:

Zone	Fossil fuels	Electric heating	
H1	130 kWh/m²/year	250 kWh/m²/year	all kWh concern primary energy
H2	110 kWh/m²/year	190 kWh/m²/year	
H3	80 kWh/m²/year	130 kWh/m²/year	

These consumptions are the maximum limit. To encourage the development of solar systems, the legislation state that a limit 20% lower for private houses and 10% lower for collective building is applied if solar energy is not used for hot water. Hence, energy has to be saved thanks to insulation and efficient systems.

Moreover if air conditioning is planned, the maximum consumption is not raised. Then the builder has to reduce the consumption of other sources (insulations and efficiencies) in order to allocate an amount of energy to air conditioning.

Finally, the solar collectors used have to be certified by the national certification scheme for solar thermal products: CSTB mark or the European certification (Solar Keymark) or equivalent. Moreover, the installation has to be done by a qualified professional having signed the "Qualisol" convention.

Austria (source: AEE INTEC)

In Austria no regulations exist within the building law. However, in the public subsidies schemes for residential buildings there are specific requirements that need to be fulfilled if subsidies shall be paid.

Spain (source: Ikerlan)

In Spain, CTE Code for New Buildings is currently in force and foresees at least a defined solar installation for DHW.

O18. Recast of the EPBD

The provisions of the Energy Performance of Buildings Directive cover, among others, energy needs for space and hot water heating and cooling for new and existing, residential and non-residential buildings. In specific, the EPBD refers to the following:

1. Minimum energy performance requirements of buildings

   The energy performance of buildings should be calculated on the basis of a methodology, which may be differentiated at national and regional level, and it includes heating and air-conditioning installations.

   The requirements shall in particular cover the following components:
   (a) Boilers or other heat generators of heating systems;
   (b) Water heaters in hot water systems;
   (c) Central air conditioning unit or cold generator in air-conditioning systems.

2. Energy performance certificates for buildings

   The certificate should, besides, provide information about the actual impact of heating and cooling on the energy needs of the building, on its primary energy consumption and on carbon dioxide emissions.

3. Inspection of heating and air-conditioning systems

   Regular inspection of heating and air-conditioning systems by qualified personnel contributes to maintaining their correct adjustment in accordance with the product specification and in that way ensures optimal performance from an environmental, safety and energy point of view. An independent assessment of the entire heating and air-conditioning system should occur at regular intervals during the life-cycle thereof, especially before their replacement or retrofitting.

The above measures disposed by the EPBD will play a significant role in the future selection or enhancement of heating and cooling systems of a building. Especially, through the issuance of an energy performance certificate, the chances of a SC+ system to be implemented into small-scaled buildings increase a lot, considering the sustainability, the reduction of primary energy consumption and the CO2 emissions savings achieved.

2.4 Threats

2.4.1 Technical issues

T1. Competing technologies' capability of covering peak demand

Most of the competing technologies using fossil-fuels or electricity are controllable by the user. This means that they can be chosen in a way that they are able to cover the most extreme heating/cooling needs, operating at part load for the rest of the time. In the contrary, the SC+ systems are dimensioned to cover the average load, assuming that the periods that the demand exceeds their nominal output are negligible.

T2. Already installed conventional systems in existing buildings (non-worthy replacement)

As evaluated in the economic analysis conducted in D2.4, the payback period for replacing an already installed system by a SC+ (without subsidies), one is too long to be considered a worthy investment.

T3. PV driven compression chillers

A significant competing technology for solar thermal systems is the photovoltaic technology that can both provide the building with electricity as well as be the driving force for a compression chiller. Moreover, less space is required for installing such a PV driven compression chiller.

2.4.2 Cost-related parameters

T4. Volatile input material costs (e.g. copper)

An issue that can be considered as a threat for the examined technology is the respective markets for the input material. As other products, such as metals and chemicals have also fluctuating prices (for instance, copper's price is rather volatile), the manufacturing costs can be significantly affected.

2.4.3 Financial incentives

T5. Lack of powerful incentives

In the section of opportunities, the available (financial) incentives in each participating country were mentioned. However, in some countries the incentives are limited to a mere income tax deduction or are presented as indirect incentives. They are, therefore, not strong enough to currently become driving mechanisms for the opening of the market.

T6. Available financial incentives for competing technologies

A significant threat for the SC+ technology is the presence of financial and other incentives for competing renewable technologies in the respective countries. Actually, most of the incentives mentioned in the section of "opportunities" refer to renewable energy technologies in general, rather than specified for solar thermal installations.

Germany (source: ISE Fraunhofer)

Germany's market incentive program of BAFA has funding mechanisms for renewable energies in general.

Italy (source: EURAC)

In Italy, the Law no.244 of 24 December 2007 valid until 2010, regulates also the incentives for the replacement, integral or partial, of existing heating systems with high-efficiency ones – i.e. condensing boilers, biomass boiler, high-efficiency heat pumps and low-enthalpy geothermal systems.

Moreover, incentives for other RES applications are mainly focused on the electricity production and energy saving. In specific for Energy Saving the following incentives are in force:

- White Certificates: they certificate that a certain reduction of energy consumption has been attained. In most applications, the white certificates are tradable and combined with an obligation to achieve a certain target of energy savings.

- Income-tax deductions till 55% of the first cost for energetic refurbishment of building concerning the replacement of thermal insulation.

France (source: TECSOL)

Correspondingly, France's incentives for private installations also include the wide field of renewable energy sources and energy efficiency, rather than merely solar thermal energy. Moreover, tax credits exist on the following equipment:

- 25% of the cost for condensation boilers. Grant available up till 2012.

- 50% of the cost for RES except biomass. Grant available up till 2012
- 40% (since 2009) for biomass boilers and heat pumps used for heating at least (except air/air). This grant will be reduced to 25% in 2010.

Greece (source: CRES)

In Greece, the tax deduction program corresponds to off-grid RES systems, thermal solar heating & natural gas systems and thermal insulation retrofits.

Spain (source: Ikerlan)

In Spain, from the agreement between IDAE (Instituto para la Diversificación y el Ahorro de Energía www.idae.es) and EVE (ente Vasco de la Energía www.eve.es) for 2009, the framework to promote renewable energies consists of the following:

- A maximum subsidy for biomass applications is 40%.
- Subsidies for solar photovoltaic or photovoltaic and wind energy applications.
- A maximum subsidy for geothermal applications is 30%.
- A maximum subsidy for biogas applications is 30%.
- A maximum subsidy for biomass treatment equipment is 30%.
- A maximum subsidy for bio-fuel services areas is 40%.

Austria (source: AEE INTEC)

In Austria, the following incentives apply to competing technologies:

- Biomass

In the each province there is a differing existing amount of subsidies for biomass driven boilers. For example, the subsidy in Styria for a pellets boiler amounts 1,400 EUR for a detached house. In particular, some communities are supporting the installation of a biomass boiler. Additionally, temporary incentive programs might be running. Up to January 2009, 800 EUR could be additionally obtained for the installation of a pellets boiler from the Climate Energy Fund.

In the case of a refurbishment, it is possible to get fiscal benefits by installing a biomass driven boiler up to 300 EUR.

For commercial buildings there is a subsidy that has to be submitted to the federal government.

In the framework of the additional Refurbishment Incentive Program “Refurbishment Check” it is possible to get subsidy from the federal government as well for a biomass boiler. This federal subsidy can be obtained additionally to the province-subsidies.

- Heat pump

For the installation of heat pumps there is a financial advantage within the public subsidies for residential buildings through the provinces. No Austrian federal direct subsidy is available. However, some communities are supporting the installation of heat pumps.

- Photovoltaics

The provinces give direct subsidies for the investment cost. For instance, in Styria this is 50 EUR/m² module area plus 500 EUR base rate. A feed-in tariff is arranged, which depends on the supplier, region and time of installation. This is defined in the Green Electricity Law Austrian wide.

Sometimes there are additional direct subsidies available from the government with a limited budget. In the year 2009 18 million Euros were available, with a maximum subsidy-height of 2,500 EUR/kW peak respectively 3,200 EUR/kW peak in the case of building integration of the panels. Such kind of subsidy is, however, utilized within a short time.

Some communities are supporting photovoltaic as well.

Within the public subsidies for residential buildings the installation of photovoltaic is reviewed in a positive way.

2.4.4 Market related parameters

T7. Lack of awareness for the wider public

From the market's point of view, a major issue is the unawareness of the wider public. Factors such as the early age of the technology, the lack of investments and publicity and, most importantly, the lack of local retailers have contributed in keeping this technology rather unknown as a significant alternative of conventional technologies.

T8. End user's behavior relates with system's performance

The system cannot be considered independently of the end user's behavior. That is, the user's awareness on energy efficiency, sustainability and environmental concerns play an important role on the way the system is operated and managed. An irrational use could signify also a decline of the performance whereas the frequent commitment of the auxiliary system will affect the system's advantage regarding low operating cost.

2.4.5 Legislation

T9. Legislation in favor of competing technologies

Similarly to the financial incentives, a number of guidelines may promote directly or indirectly the installation of competing technologies, especially in regards with renewable energy systems.

Germany (source: ISE Fraunhofer)

In Germany the regulation EEWärmeG concerns not only solar thermal applications, but renewable energy systems in general. For instance, the obligation for solar thermal installations can be substituted by biomass (see…)

Italy (source: EURAC)

The Italian building codes mentioned in XX – Legislative Decree no.192 and Legislative Decree no.311 – also refer to the implementation of renewable energy technologies in general, being a threat for the SC+ systems.

Moreover, Law no.14 of 27 February 2009 obliges new buildings to install systems for electricity production by renewable sources (photovoltaic, biomass and wind). In detail, the electric energy production by renewable sources has to be at least of 1 kW for each housing unit and at least of 5 kW for industrial building having a surface not lower than 100m². This last code could also threaten SC+ systems’ spread, since the installation of an electricity producing technology could be proven more beneficial for the end user, who through renewable electricity may cover both the electricity demand as well as install an electric-driven system for cooling.

France (source: TECSOL)

In France, the Thermal Regulation 2005 and the “energy economy certificate” also promote renewable energy technologies or energy efficiency in general rather than solar thermal systems only.

3 Results – Conclusions

The following table summarizes the SWOT Analysis conducted previously.

	Strengths	Weaknesses
Technical	**S1.** High electrical COP and high potential for further increase of SC+ system's efficiency **S2.** Compatibility with conventional heating/cooling & existing distribution systems **S3.** Extension of the use of existing ST systems (DHW) **S4.** Best configurations result in high performance operation **S5.** Stand alone systems for covering base cooling loads **S6.** Tailor-made systems achieving better performance **S7.** Improvement of storage capabilities of SC+ systems **S8.** Future development of standard design systems **S9.** Less losses of transformation from PE to electricity **S10.** New applications emerging	**W1.** Storage required **W2.** Large unoccupied area required **W3.** An auxiliary system required **W4.** Not efficient for all different combinations of location/application **W5.** Not standardized and available off-the-shelf yet
Cost-related parameters	**S11.** Relatively low operating cost (in off-gas mode: eg, cooling) **S12.** Almost independent of energy markets	**W6.** High capital cost **W7.** Non-negligible operating cost **W8.** No economies of scale **W9.** Relatively high installation and transportation cost **W10.** Relatively high maintenance cost
Marketing aspects	**S13.** Relatively good cost of primary energy saved **S14.** 3-in-1 features: One product solves 3 needs for the user **S15.** Positive environmental profile – Mitigation of CO2 emissions **S16.** State of art equipment / system **S17.** Production plants location **S18.** Existing installation as best practices	**W11.** Limited operating experience – No reviews and testimonials of existing installations yet **W12.** Lack of local retailers **W13.** Limited market applications **W14.** Aesthetics **W15.** Lack of user friendly interface and automated features **W16.** Non-adequately trained technical personnel **W17.** No trademarks currently in force
	Opportunities	**Threats**
Technical	**O1.** Locations with good solar irradiation – high cooling loads – high fuel prices **O2.** Isolated buildings/regions **O3.** No significant future improvement of fossil-fuel technologies foreseen (efficiency) **O4.** Future building integration **O5.** Standardization **O6.** Improvement of manufacturing technologies	**T1.** Competing technologies' capability of covering peak demand **T2.** Already installed conventional systems in existing buildings (non-worthy replacement) **T3.** PV driven compression chillers
Cost-related parameters	**O7.** Increase in fuel prices **O8.** Cheaper than electric-driven compression chillers	**T4.** Volatile input material costs (e.g. copper)
Financial incentives	**O9.** Available financial incentives per country (ask partners) **O10.** Prospects for financial incentives (current preparation – discussion on upcoming legislation) **O11.** Proposal for green tax package	**T5.** Lack of powerful incentives **T6.** Available financial incentives for competing technologies
Market related parameters	**O12.** Large labor pool available due to recession **O13.** Opening of jobs, businesses, companies - companies - New geographic markets emerging outside the EU **O14.** Promotion of sustainability (e.g. UN Climate Change Conference 2009) **O15.** "Pioneers" and "front runners" both in green technology and environment protection are looking to invest and buy new technology. **O16.** Target specific user's profile	**T7.** Lack of awareness for the wider public **T8.** End user's behavior relates with system's performance
Legislation	**O17.** EU (or national) -Legislation (particularly public sector) for the employment of RES **O18.** Recast of the EPBD	**T9.** Legislation in favor of competing technologies

The SWOT Analysis is a powerful tool for the market analysis of the examined technology, as it summarizes and visually represents advantages and disadvantages as well as the potentials for a successful market establishment. It can be independently used and applied to specific applications or regions and, therefore, become the starting point for the definition of specific goals and targets.

To summarize the aforementioned outcomes, the SC+ system is advantageous in terms of technology, being an innovative and efficient system, with further prospects of improvement, due to its current market phase. Characterized by high electrical COP and a total Solar Fraction sometimes reaching over 90%, it can effectively compete not only conventional systems but also other sustainable technologies.

The increasing installations can play an important role to its further recognition, while the work accomplished in the framework of the SC+ project regarding the definition of standard system configurations will be the first step for a European – international standardization.

In terms of cost efficiency, the technology's currently high capital cost is compensated by the relatively low operating cost. An added value to the economic feasibility of the technology is offered through the various financial incentives currently in force in the European countries and the overall European policy and strategy towards a sustainable future. However, effort should be laid in mobilizing the relevant mechanisms for the introduction of new incentives in European level that offer a distinguishing and specified support to small scaled solar thermal systems, as well as taking advantage of regulations concerning the energy efficiency and sustainability of buildings.

Nevertheless, certain drawbacks of the technology as well as the threats met in the market should be individually addressed as problems.

A noteworthy issue that somehow hinders the wide penetration of SC+ systems in the market is the difficulty in standardizing the systems in terms of technology. Each examined system manufactured/sold by the project's industrial partners has unique technical characteristics influencing its operation, performance, component dimensioning and optimal application/location. This suggests that, for now, the chillers can be fairly good standardized on technological level (i.e. manufacturer), but they cannot be easily standardized on market level as a whole.

Further effort should be laid for both enhancing the technology and establishing a wider approval, through creating economies of scale as well as defining market goals, identifying competent promotion means and push it to the most promising market areas.

4 References

(1) ESTTP, Solar Heating and Cooling for a Sustainable Energy Future in Europe, supported by FP6

(2) Tom A. Williams, Gary Burch, James M. Chavez, A long-term strategic plan for development of solar thermal electric technology, Energy Conversion Engineering Conference, 1997. IECEC-97., Proceedings of the 32nd Intersociety, Volume 3, Issue, 27 Jul-1 Aug 1997 Page(s):1901 - 1906 vol.3

(3) Association Management, Consulting & Evaluation Services, www.amces.com

(4) COM(2008) 781 final, Second Strategic Energy Review: An EU Energy Security And Solidarity Action Plan

(5) COM(2008) 780 final, Proposal for a Directive Of The European Parliament And Of The Council on the energy performance of buildings (recast)

(6) SC+ project deliverables D2.1, D2.2, D2.3

(7) SC+ project deliverables D2.4, D2.5

(8) SC+ project deliverables D3.2, D3.3

(9) SC+ project deliverable D4.1