Solar Combi+: Identification of most promising markets and promotion of standardised system configurations for small scale solar heating & cooling applications

A. Troi[1*], Y. Vougiouklakis[2], E. Korma[2], D. Jähnig[3], E. Wiemken[4], G. Franchini[5], D. Mugnier[6], B. Egilegor[7], P. Melograno[1], W. Sparber[1]

[1] EURAC, Institute for Renewable Energy, Viale Druso, 1, 39100 Bolzano, Italy

[2] CRES, Centre for Renewable Energy Systems, 19th km Marathonos Ave.,190 09 Pikermi, Greece

[3] AEE INTEC, Institute for Sustainable Technolgies, Feldgasse 19, 8200 Gleisdorf, Austria

[4] Fraunhofer Institut für Solare Energiesysteme (ISE), Heidenhofstraße 2, 79110 Freiburg, Germany

[5] Università degli studi di Bergamo, viale Marconi, 5, 24044 Dalmine (BG), Italy

[6] TECSOL, 105 rue Alfred Kastler, 66000 Perpignan, France

[7] Ikerlan Technological Research Centre, Juan de la Cierva, 1, 01510 Miñano (Álava), Spain

[*] Corresponding Author, alexandra.troi@eurac.edu

Abstract

In autumn 2007 the European project SolarCombi+ has been started. The aim of this project is to take newly commercially available small scale sorption chillers and identify and promote standardised Solar Combi+ systems for small applications: i.e. combined solar water and space heating and cooling up to a cooling load of 20 kW. A thorough market study at project start outlined the possible markets - both in the sense of applications and countries of major interest - and described promising consumer attitudes: 40% of them are even willing to pay more for a product if it is energy efficient - Solar Combi+ systems can have a significant market if they are as reliable and convenient as conventional air conditioning systems even if they are somewhat more expensive. A large number of Virtual Case studies will now be performed in order to identify a standard system configurations, which work best under different conditions. Accelerating and smoothing the market entry of small scale Solar Combi+, the project will contribute to achieving energy policy goals of the EU.

Keywords: solar cooling, small scale sorption chillers, market analysis, standard systems

1. Introduction

The combined use of solar energy for heating and cooling has the potential to upgrade solar thermal energy from mainly DHW provider to a major building energy supplier [1, 2] The hereto necessary sorption chillers, however, used to be available mainly in higher power range [3], but now several new small scale sorption chillers are being offered. They will open the market for small cooling applications, which make up for the major part of heating and a constantly growing part of cooling demand in Europe.

Aim of the here presented IEE[1] funded project "Solar Combi+" is to take these newly commercially available small scale sorption chillers and identify and promote standardised Solar Combi+ systems for small applications (residential, catering, small commercial and office buildings, up to a cooling demand of 20kW).

[1] Intelligent Energy Europe

Now is the right moment to support the market entry of Solar Combi+ with reliable dimensioning and a comprehensive analysis of promising applications. In this way the spread of Solar Combi+ can go hand in hand with the build up of important solar thermal markets for e.g. Spain, France and Italy [4]. One has also to regard, that cooling applications are state of the art in office and commercial buildings not only in southern countries but all over Europe, and comfort requirements in residential sector is constantly growing.

The participation of all European producers of small scale solar driven sorption chillers as direct partners as well as the declaration of interest of the solar thermal industry, shows the importance of the project for a smooth and sustainable market entry of Solar Combi+ systems.

This paper should give an overview on the rationale behind the project, its goals and its approach, as well as present the market situation: After describing with more detail the addressed barriers and offered solution, the technology is briefly summarised, the work plan of the project is presented and first results of the market analysis are discussed. The paper closes with an outlook on up-coming results and the impact which is expected from the project.

2. Solar Combi+ systems

Solar Combi+ systems use heat from solar thermal collectors to provide heating in winter, cooling and summer and domestic hot water all the year round. Fig. 1 sketches the main components, which make up a typical system: (i) the solar thermal collector to provide the heat might be backed up by another heat source, (ii) a storage tank can either be installed on the warm side, as drawn in the figure, on the cold side or on both, (iii) the domestic hot water tank might be included in the hot storage or be a separate tank, (iv) the sorption chiller is fed with hot water (70-100°C), (v) rejects heat at intermediate temperature (30-40°C) to a cooling tower (dry, wet) or another heat sink (as e.g. a swimming pool) and (vi) delivers chilled water to the cold distribution (be it a chilled ceiling, fan-coils or air handling units), whereas (vii) the heat distribution should possibly be a low temperature system.

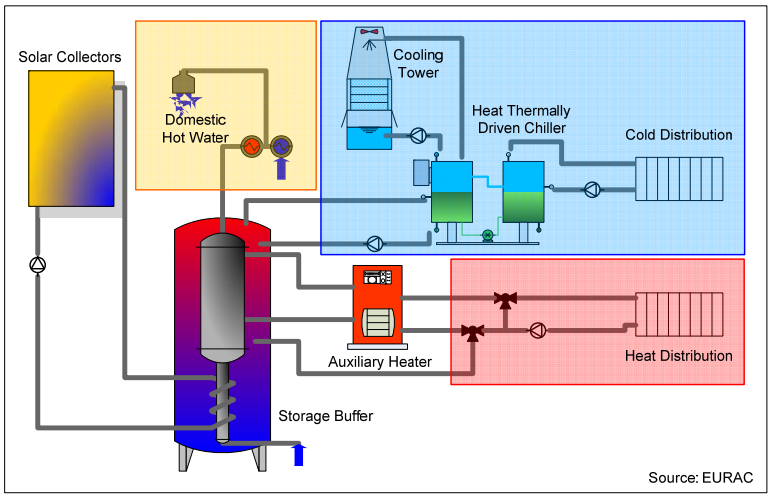

Fig. 1. Example for the system components of a Solar Combi + System and project logo

All the single components of a system are now market available: But there is so far hardly a provider of system solutions, and that's the point where the project is puts efforts forth.

3. Addressed barriers and offered solutions

The most important barriers for a broad application of small scale combined solar heating and cooling systems – further on called Solar Combi+ - and the solutions proposed by the project to overcome them are as follows:

1. Combined solar heating and cooling needs specialised design in order to make the single components play together optimally. So far every single system is designed from scratch. This (i) leads to a financial effort, which is not feasible for small applications, as design costs become prohibitively high in relation to hardware costs and (ii) often might overstrain the solar thermal installer, who would in most cases be the provider of the system to the end-user. Today there are no design guidelines for small scale systems and very few, yet not validated, package solutions on the market.

→ Virtual case studies will overcome this gap: Promising configurations will be identified, simulated for different typical conditions (i.e. utilization, climate, building type) and finally economically and ecologically rated. Out of the large number of virtual case studies, a small number of standard system configurations, which work best under different conditions are identified. Based on these, small scale sorption chiller and solar thermal industry will be able to provide consistent package solutions. These will enable planers and independent craftsmen to install reliable systems.

2. Small scale sorption chillers are expensive as production volumes are currently low.

→ The economical and ecological rating of the above described virtual case studies will allow identifying the most promising markets, where systems are yet at the edge of economical breakeven point or beyond, compared to traditional solutions. Accordingly tailored promotion and market strategies will considerably trigger the application of the technology. Following economies of scale will make small scale combined solar heating & cooling less expensive and thus viable in a broader range of applications and climates.

3. Small scale combined solar heating & cooling is not well known by traditional small scale solar thermal installers, planners, architects and potential clients.

→ Tailored dissemination plans include among other measures the training of solar thermal installers, targeted presentations to professionals, information of the public in most promising regions as well as advice to policy makers and promotion of pilot plant installation to public authorities.

4. Solar Combi + work plan

4.1. Market analysis

The market analysis provides an in depth analysis of markets for small scale SolarCombi+ and serves as a basis for the definition of the cases to be studied in WP3. It is performed on three pillars: (i) small scale chillers, (ii) solar thermal applications and (iii) consumers. The ecologically and economically rated case studies of WP3 are on the other hand the basis for a SWOT analysis, the examination of market shares and definition of goals.

4.2. Virtual case studies

Based on the results of the market analysis and on the experience with installed systems up to now, promising configurations will be identified, simulated for different typical conditions (i.e. utilization, climate, building type) and finally economically and ecologically rated.

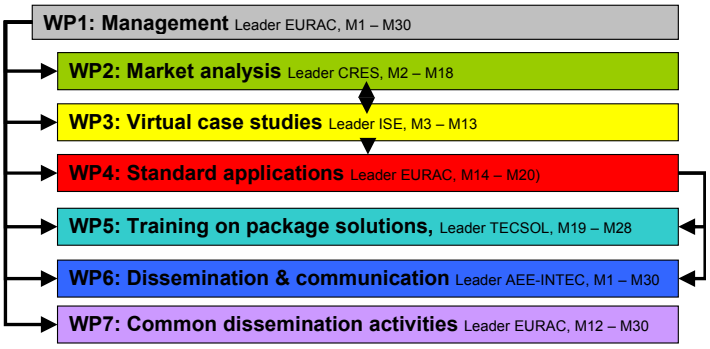

Fig. 2 Structure of the work plan

4.3. Evaluation of virtual case studies

Out of the large number of virtual case studies, a handy number of standard system configurations, which work best under different conditions, are identified. Based on these, the industry partners will provide consistent package solutions. These will enable planers and independent craftsmen to install reliable systems. The economical and ecological rating of the virtual case studies will also allow identifying the most promising markets, where systems are yet at the edge of economical breakeven point or beyond. Last but not least the results of the virtual case studies will be made available online with an easy to handle web-based tool, which can query it under different aspects.

4.4. Training on package solutions

Special training courses for solar thermal installers on standard system configurations and package solutions will be prepared and 15 pilot courses will be evaluated. Target group are (solar thermal) installers, because the goal of the packaged solutions is to avoid the need of engineering.

4.5. Dissemination, communication and training

Tailored dissemination, communication and training plans were elaborated to reach the different key actors. They include besides the presentation of results at relevant conferences and trade fairs addressing a wider audience (i) the dissemination of both the elaborated brochure and the online tool to query the virtual study cases towards professional groups (HVAC planners, architects, engineers, building industry), through their interest groups and associations (e.g. ESTIF, ECTP, chambers), where possible on the occasion of annual meetings or in synergy with related national and international projects, (ii) the provision of information and advice to (national) authorities on the potential of Solar Combi+ with the aim to include it in support programmes and (iii) the approach of local authorities in promising regions promoting pilot installations. Finally, information through public media in the most promising regions should give an important push to market entry. On the website all public deliverables will be available for download and most attention is given to the integration of the webpage in the existing information network on solar heating in general and combined solar heating and cooling in special.

5. Market analysis

5.1. Market situations and trends of small scale chillers

The first part of the project was devoted to an analysis of possible markets for Solar Combi+ systems. Since the competing technology are conventional (non-solar) air conditioning systems, the available technological solutions with small cooling capacity as well as their markets in Europe were analysed.

The European Air Conditioning (AC) market has grown rapidly during the last 5 years. The size of AC markets in the seven major European countries (France, Germany, Greece, Italy, Russia, Spain and the UK) expanded from some 2.4 million sold units in 2000 to 5 million sold units in 2004. A further breakdown of the European AC market reveals that Italy and Spain are holding the largest market of about 1.4 to 1.7 million units per year (after 2004), followed by France, Greece and UK at 300,000 to 500,000 units each [5, 6].

For small cooling demands, typically room air-conditioning units or multi-split systems are used, as can be seen from a closer look at the France and the Italian markets can be stated that especially the monosplit units with small capacities are responsible for more than 50% of the overall sold units (see Figure 3 and 4). Application areas for these systems are mainly in smaller buildings such as the trade and residential sector and small office buildings where in the past mainly local solutions were used.

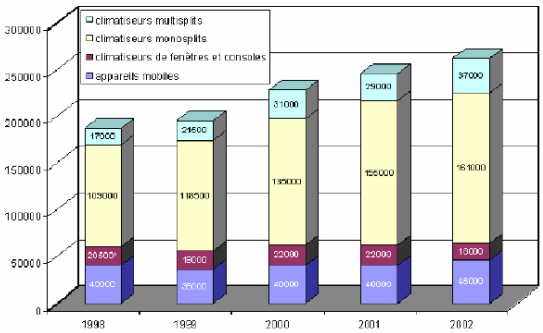

Fig. 3. Evolution of the air conditioning market of individual air conditioners with a capacity below 17,5 kW in France. Sold units in the years 1998-2003

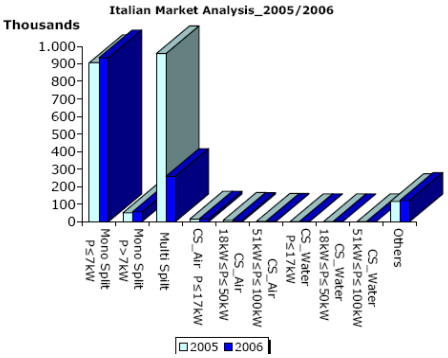

Fig. 4. Share of air conditioners with different capacities on the overall Italian market in the years 2005 and 2006 [7]

However, small chiller systems have an increasing market share in many European countries. These smaller buildings are seen as the most promising target market for solar combi plus systems, which offer a central chiller system powered by solar heat (see Fig.5). The survey among the industrial participants of the SolarCombi+ project also showed that they see the most interesting markets for their Solar Combi+ systems in Spain, Italy and France (see Fig. 6).

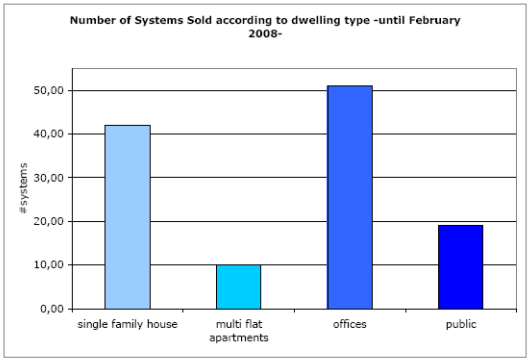

Fig. 5. Number of systems sold until Feb. 2008, as reported by the SolarCombi+ industry partners

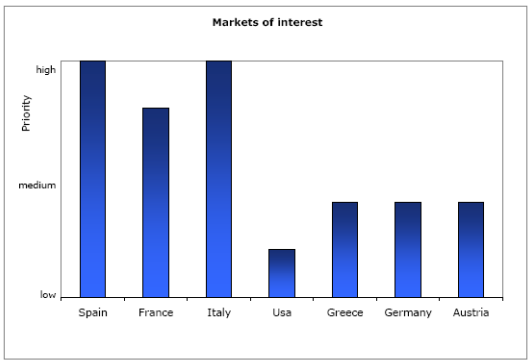

Fig. 6. Markets which are considered of high priority by the SolarCombi+ industry partners

5.3. Solar thermal markets in Europe

Currently, solar thermal markets are growing all over Europe (see Fig. 7), even if with different path and different focus: Germany is still the largest market; Austria and Greece are among countries with the highest per capita collector area, but while in the first solar combi systems become increasingly important (35% of installed area), in the latter dominate thermosiphonic systems for DHW; other southern European countries as e.g. Spain and France are catching up now. Solar combi plus systems have a large potential here because systems can be used year around for DHW, pool heating, space heating and last but not least cooling. Although small solar combi plus systems are relatively new to the market, sales are rapidly increasing. The industrial partners involved in this project have already installed more than 130 systems all over Europe.

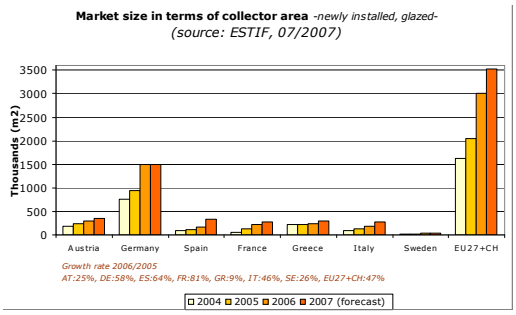

Fig. 7. Thermal market in participating countries

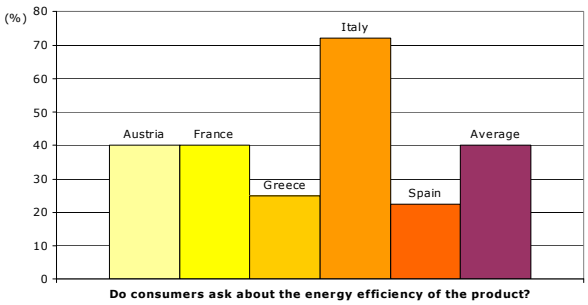

Fig. 8. Answers to the question, whether consumers ask retailers about energy efficiency

5.4. Air conditioning costumer needs

To estimate the potential of small scale Solar Combi+ systems, a market survey among AC systems retailers was conducted - the target group being the consumers, but the source to collect and analyze the necessary data the retailers, who could provide data not only on volume of sales but also on consumers attitude. Even if the research partners faced some difficulties in approaching retailers and collecting information, the filled questionnaires (elaborated by CRES) reveal some interesting aspects, which are presented here (the full report is available on the project website [8]).

Results are in line with the EU-survey of "consumer attitudes related to EU Energy policy" [9], which states that 80% of EU citizens say energy efficiency influences their decision when buying household appliances (nearly half of them very much) and that they are quite certain that within the next decade they have to change their every day behaviour, but also the technology used to make their living space comfortable. The Solar Combi+ survey in fact illustrates, that also in the selection of air conditioning systems in almost all countries in Europe, energy efficiency is a major topic (see Fig. 8). This has a clear consequence on the selected products. In fact in Italy most products sold are classified as energy class A while in Greece more class B and C than class A products are sold. (see Fig. 9).

While other criteria such as maintenance effort, noise, the trademark, aesthetics – and total cost! - are also important aspects when buying air conditioning systems (Fig. 10), a high percentage of consumers pay attention to energy label and efficiency data. 40% of them are even willing to pay more for a product if it is energy efficient (Fig. 11). This survey shows that Solar Combi+ systems can have a significant market if they are as reliable and convenient as conventional air conditioning systems even if they are somewhat more expensive.

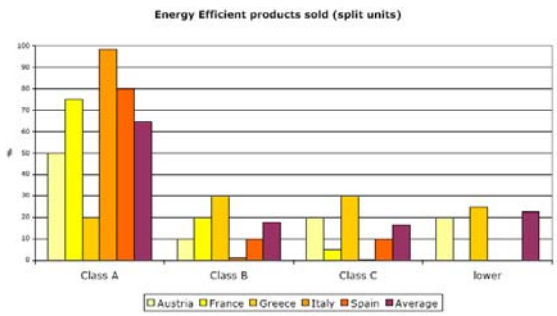

Figure 1 –Answers to the question how many percent of the sold products belong to which energy class.

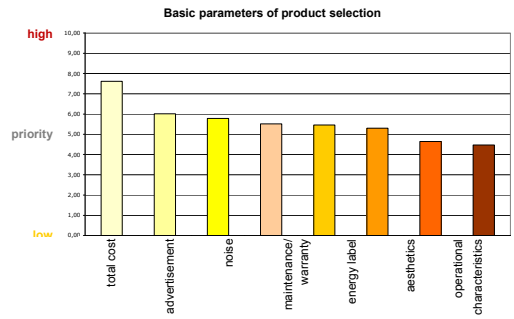

Fig. 9. Basic parameters of product selection

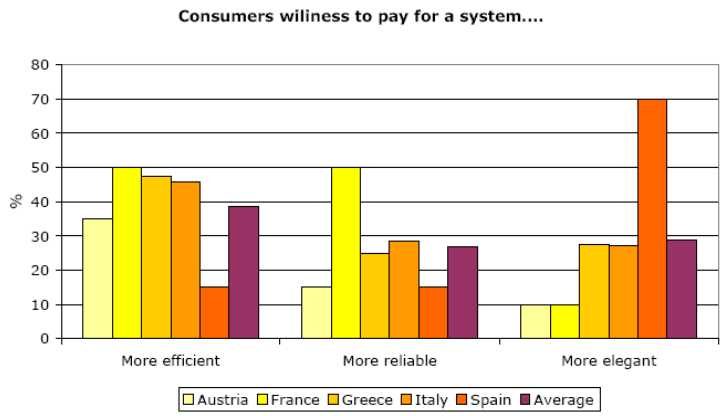

Figure 10. Costumer's willingness to pay more for a product that is: More efficient? More reliable? More Elegant?

6. Conclusion

By the end of the project, validated standard system configurations for small scale combined heating and cooling will be at the disposal of solar thermal industry, producers of sorption chillers and system providers.

The participating companies will accordingly be able to offer their own package solutions. These pre-engineered systems will enable installers to offer the technology to customers and to promote it, thus triggering the pull market in a considerable way.

A detailed database which will be publicly available will result from the analysis of a broad range of technologies, applications and climate. It will provide in depth information on all important aspects of small scale combined solar heating & cooling for several key actors. The technical, economical and ecological evaluation of cases will be useful for involved industry and planers as well as for authorities.

For example can the project also contribute to tailored shaping of support programmes. The provided knowledge on economical and ecological performance of combined heating and cooling for different regions facilitates the establishment, where necessary and required at all, of long term support schemes. An avoidance of stop and go support would this way further smooth market entry [1].

The combined use of solar thermal for heating & cooling can accelerate the evolution of solar thermal from only domestic hot water supply to a significant contributor to heating demand by

increasing cost efficiency of the entire system, this way mitigating the threats of Europe's growing heat and cooling demands[10] [11]. And the increased utilization of sorption chillers will mitigate summer electricity peak demand, a major threat in some European countries (e.g. Italy [12]).

Accelerating and smoothing the market entry of small scale Solar Combi+ systems, the project will contribute considerably to achieving important energy policy goals of the European Union; in particular relating to the share of renewable energies [13] and the security of energy supply in the EU [14].

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