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SHC - TASK 26

Solar Combisystems

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INTERNATIONAL ENERGY AGENCY
Solar Heating & Cooling Programme
www.iea-shc.org/task26

Background

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Solar heating systems for combined domestic hot water preparation and space heating, so called solar combisystems, are increasing their market share in several countries. An overview of the combisystems currently encountered in the ten countries participating in Task 26 may be found at www.iea-shc.org/task26 beginning in November 2000 or can be obtained from the respective national contact person (see below the list of participants).

This first document prepared by Task 26 shows a number of examples of architectural integration of solar collectors in existing and new buildings, presents basic features of solar combisystems and includes market figures.

The European Commission's strategic goal with respect to future development in the field of renewable sources of energy in the member states is a total collector area in operation of 100 million square metres by 2010. To achieve this goal requires an increase of 20% per year from the current value of 18 million square metres. Fig. 1 shows this required growth and includes the assumption of a market share of 20% for solar combisystems.

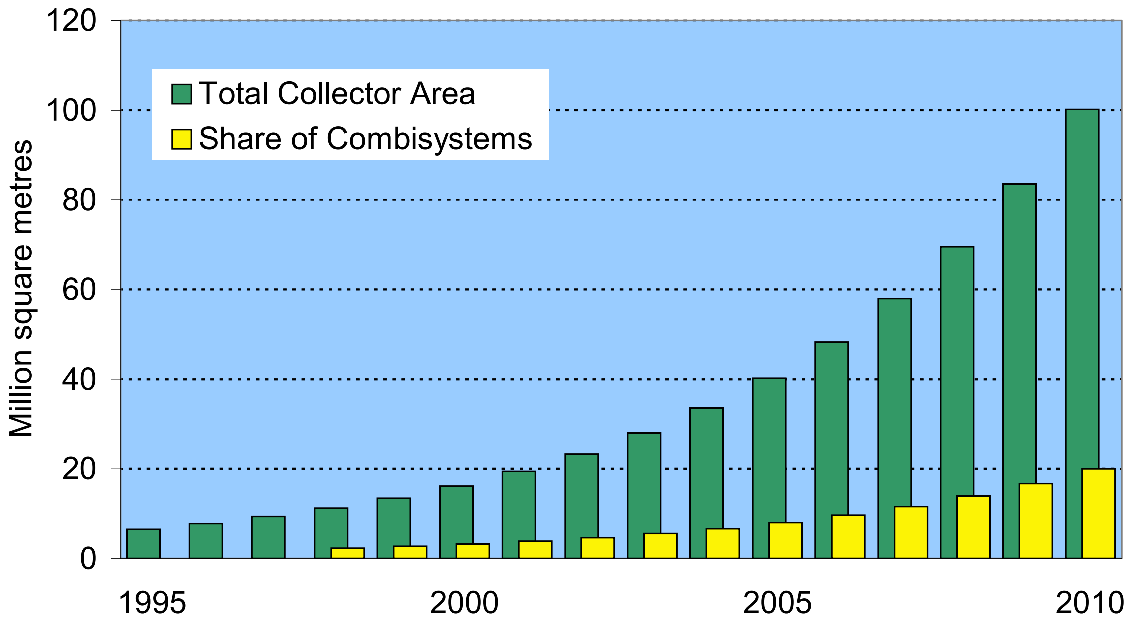

Fig. 1: Total collector area in operation targeted by the European Commission as a strategic goal with respect to future development in the field of renewable sources of energy in the member states. The estimated yearly increase in the total collector area is 20% [1]. Market share of solar combisystems is estimated to be 20%.

Solar combisystems are one of the key technologies to reduce carbon dioxide emissions, a necessity forced by global warming. Companies that enter the market early will have a significant commercial advantage at the (expected) time of this technologies massive expansion. Join us right now! This is a challenging innovative technology that will also generate many new jobs.

Much is already known about solar domestic hot water systems, but solar combisystems are more complex and have interaction with extra subsystems. These interactions profoundly affect the overall performance of the solar part of the system. Current designs result mainly from field experiences and consequently have not yet been carefully optimised. Task 26 aims at filling this gap. Task 26 is optimising combisystems from a technical and economical point of view, to improve their acceptance in the marketplace.

Task 26 is a major research project of the International Energy Agency (IEA) Solar Heating and Cooling Programme. The IEA, founded in 1974, is an autonomous body within the framework of the Organisation for Economic Co-operation and Development (OECD). Twenty four member countries and the European Commission carry out a comprehensive programme of energy co-operation. Policy goals include the ability to respond promptly and flexibly to energy emergencies; environmentally sustainable provision and efficient use of energy; research, development and market deployment of new and improved technologies; and co-operation among energy market participants.

These goals are addressed within the framework of 40 Implementing Agreements. One of the first R&D Implementing Agreements of the IEA was the «Solar Heating and Cooling Programme» (SHC). Since 1977 in the SHC twenty-six projects or "Tasks" have been undertaken.

Task 26 was launched at the end of 1998, it involves 32 experts from nine European countries and the USA and 15 solar industries. The goal of this research project is to further develop and optimise solar combisystems for detached single-family houses, groups of single-family houses, and multi-family houses with their own heating installations. Furthermore, standardised classification and evaluation processes are being developed for these systems within the framework of this project. These processes serve as a basis for the elaboration of suggestions for the international standardisation of combisystem test procedures. Task 26 will be completed by the end of 2001. A comprehensive survey on solar combisystem design and good practice will be the end deliverable from the Task.

Industry Workshops


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Task 26 activities of particular interest for industry are the **Industry Workshops** organised twice a year in conjunction with the semi-annual Expert's Meetings. Industry Workshops serve as a forum for information exchange between scientists and the industry: Companies pose questions addressing the current and future research and receive recent information from the results already achieved.

Each Industry Workshop focuses on one or two particular subjects for 5 to 6 hours. Some examples from the past three workshops:

- strategies to prevent damages from stagnation in the collector array
- experience from solar combisystems used in conjunction with wood as the auxiliary energy source
- natural convection flows in a water storage tank used as a heat store
- evolution of the solar heating system markets in the participating countries
- innovative circulating pumps for solar heating systems
- new materials and components for solar heating systems

The workshops take place each time in a different participating country. The next two Industry Workshops are scheduled as follows:

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Subtasks

Task 26 is structured in three subtasks, denoted by A, B and C. Subtask A deals with global aspects and the dissemination of the Task results. Subtask B develops performance test methods and numerical models for combisystems and their components. Subtask C optimises combisystems for the market.

Further information about Task 26 may be obtained from the National Contact Persons listed at www.iea-shc.org/task26.

A

Solar Combisystems Survey and Dissemination of Task Results

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Communication and synthesis are the central issues addressed by Subtask A. Subtask A collects information about existing combisystems in the participating countries. In particular, it established a

survey of the different system types, called generic systems, which are sold on the respective markets. Subtask A creates a synthesis of Subtasks B and C results and adapts their presentation to the potential readers and users of Task 26 deliverables. Finally, Subtask A organises the Task 26 Industry Workshops.

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One particular issue addressed by Subtask A is the ranking and comparison of the great variety of combisystems considered by Task 26. The main differences are related to the concept of the heat storage and heat management within the system: although all systems may have similar collectors and supply similar heat consumers, the internal heat transfers and the intermediate heat storage are addressed quite differently from system to system. These differences lead to different performances, different costs, and different reliability/durability aspects. Examples of questions considered by Subtask A are: Which solutions should be recommended under the various boundary conditions (local climate, national economical factors, degree of thermal insulation in the considered building, etc.)? Which solutions are best qualified for future production by industry?

Subtask A is looking for global criteria giving a fair overview of the systems' qualifications. The criteria will include cost/benefit considerations as well as global dimensioning features like the installed collector area per unit of heat demand or the installed storage volume per unit of collector area. Reliability/durability aspects and user acceptance will be considered too. The future user of the Task deliverables shall be given helpful considerations to guide the design and optimisation process.

B

Development of Performance Test Methods and Numerical Models for Combisystems and their Components

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Subtask B is involved in the development of test methods and numerical models for evaluating, rating and comparing solar combisystems and their components. Models are needed to calculate thermal performances from testing and to simulate and optimise system configurations.

The aim of testing solar combisystems is twofold: the test should (1) verify good operation of the system and point out aspects requiring an improvement, and (2) deliver a prediction for the annual thermal performance of the system with an acceptable accuracy. Broad agreement on the structure for the test procedure has been achieved using applicable parts of presently available test methods. The test procedure under development should have the following features:

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- the ability to perform indoor laboratory testing with collector hardware simulation
- the ability to measure variables between the various components
- no more than 3 test periods each of no more than 4 days duration
- the choice between either a simple or detailed evaluation of the test data.

Simple evaluation does not need models but involves the determination of how components and systems function in order to provide recommendations for improvement of the tested system. The method may also give an indication of the annual system performance. The review in Subtask A shows a great variety of solar combisystems. From this point of view, simple evaluation is favourable as no model needs to be developed. However, if models are already available, their use may be advantageous.

A number of component models are already available but some are missing. Since the beginning of the Task, some missing models have been completed and others are under development. A detailed collector model has been developed and analysed with respect to accuracy. A flexible heat store model has been extended to include a fourth heat exchanger, and external heat exchanger models have been linked to manufacturers' data. A model of a heat store with an integrated burner is being developed. A building model has been defined for the calculation of the heat load in three different detached single-family houses and in a row of houses. Models for heat distribution systems are under development. However, some systems are still not possible to model with the accuracy required within the Task.

The models developed in Subtask B will be used in Subtask C for system design and optimisation and in Subtask B for testing. Industry will deliver systems for these solar combisystem tests.

C

Optimisation of Solar Combisystems for the Market

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Detailed simulations of combisystems can be used to determine promising designs taking into account different climates and buildings in the participating countries. A structure for simulating solar energy systems is available in TRNSYS, a modular computer programme coupling together component models into a more or less complex system models, according to the needs of the design or research engineer.

Subtask C launched the simulation and optimisation of 10 different designs of solar combisystems from eight countries. The same reference conditions are used for all systems, including three different climates (Stockholm, Zurich and Carpentras) and four different buildings (single-family houses with specific annual energy demand of 30, 60 and 100 kWh/m^2, and one multi-family house with 45 kWh/m^2). The comparison of the results is based on different levels of fractional energy savings relative to reference systems taking into account the efficiencies of the conventional boiler, the electricity demand of the system and the fulfilling of the consumer needs (temperatures of DHW and space heating). Cost considerations are included in the comparison.

In a first step all systems are individually optimised. In a second step a comparison of the different optimised generic concepts will be done. All the comparisons are carried out in co-operation with Subtask A.

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Level 1: Participation in 1 workshop per year and answer technical and marketing questions

Level 2: Participation in all Task meetings and provide feedback from the market

References:

[1] European Commission: White Paper for a Community Strategy and a Plan of Action, Brussels, 1998

Photos:

❶ Hotel at 2000 m altitude, Silvretta, Austria

❷ Multi-family house and kindergarten, Hohenau, Austria

❸ Chalet in the alps, Switzerland

❹ Single-family house, The Netherlands

❺ Single-family house in winter time, Jennersdorf, Austria