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CONTENTS

PUBLICATIONS AT estec2005

- New Generation of Solar Thermal Systems - an EU Project (Original version, 6 pages)
- Next Generation of Standards (Original version, 6 pages)

In total this Deliverable consists of 13 pages.

Two presentations about the NEGST project were held at the European Solar Thermal Energy Conference (estec2005) on June 21st-22nd, 2005 in Freiburg, Germany.

Two papers were published in the conference proceedings. One publication gives an overview of the whole project and informs about project results (title: New Generation of Solar Thermal Systems - an EU Project). The other publication informs about the contents of work package 4 (title: Next Generation of Standards).

New Generation of Solar Thermal Systems– an EU Project

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Introduction

Solar thermal systems can contribute to the protection of the environment and save our natural resources. Even though solar thermal systems are already well-developed at present, further dissemination of this technology requires a continuous development and optimization. In order to manage this challenge collectively on an European basis, the project “**New Generation of Solar Thermal Systems (NEGST)**” was initiated by the Institut für Thermodynamik und Wärmetechnik (ITW), University of Stuttgart together with the company “Solar- und Wärmetechnik Stuttgart” (SWT).

The project aims mainly at the development and market introduction of the next generation of solar thermal systems. This “new” system generation represents a further development of today’s system technology with respect to improvement of performance and reduction of system costs. In addition to solar thermal systems for domestic hot water (dhw) preparation, solar combisystems (systems for combined dhw and space heating) are considered, as well as systems for solar cooling and sea water desalination.

General Information on the Project

Project Participants

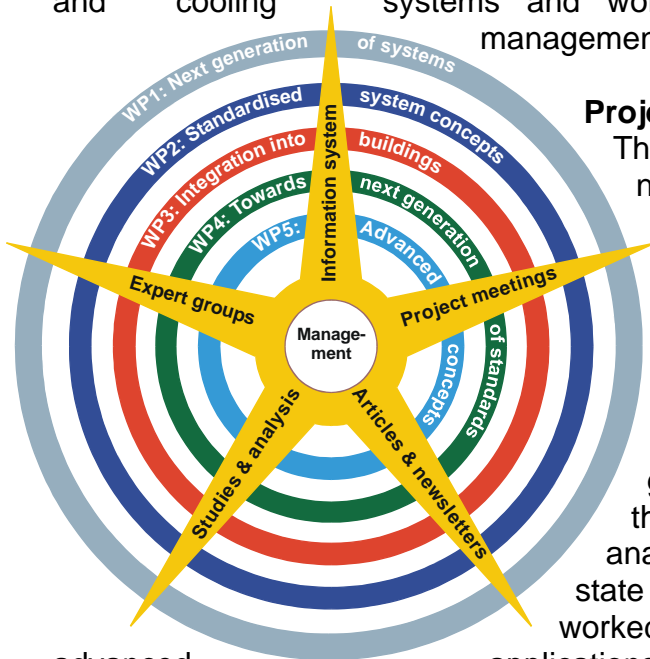
The consideration of the most important European system requirements is achieved by the involvement of 18 different institutions [1] from science, research and industry from 14 different countries. Consequently a basis for a uniform European market as requirement for further market growth has been created.

The financial contribution of the European Commission confirms the significance of solar thermal technology in Europe.

Project Scope

The project started in July 2004 and has a duration of 36 months. Project work is divided into 6 different work packages: Work package 1 aims at the development of a new generation of solar thermal systems and their introduction to the market, whereas work package 2 deals with standardised system concepts for larger solar thermal systems. Work package 3 concerns the integration of solar thermal systems in buildings and work package 4 has the objective to complete preliminary normative

work for a next generation of solar thermal system and components. Work package 5 concentrates on advanced applications like technologies of seawater desalination and cooling systems and work package 6 comprises mainly project management and the dissemination of project results.



Project Goal

The main instrument will be to create a network for the coordination of the research and innovation activities for the development of a new generation of solar thermal systems. This will be done in very close cooperation with industry. The aim is to give industry useful support in the development of a new generation of solar thermal systems to achieve the common goal of a wider market penetration of solar thermal energy in Europe. A detailed market analysis with evaluation of market situation, state of the art and market requirements will be worked out. Possibilities and chances of

advanced applications like seawater desalination or solar cooling will be evaluated. Finally, recommendations are given as to what has to be done to overcome barriers for the market introduction of innovative products.

Work packages

WP 1: Next generation of systems

The objective of this work package is the “development” of a new generation of solar thermal systems and their introduction to the market. This is done by close collaboration with industry active in the field of solar thermal systems. For that purpose a detailed survey on today’s state of the art system technology has been made and new system concepts have been evaluated. Industry and researchers have been asked to contribute their ideas and to present their next generation of systems.

The market survey on today’s system technology identifies differences in technology which are relevant in the different countries today and which may be important tomorrow. Besides it gives an overview on different market requirements, shows the distribution of solar domestic hot water and combisystems, indicates the share of installed collector area in single and multifamily houses, and includes the space heating and domestic hot water demand in the individual countries.

Meanwhile the systems were grouped in system classes with similarities and the most promising system types of these classes with the highest impact on the market have been identified. It was found that Germany is a market with high innovation potential. Therefore three of the following system types are of German origin.

An intelligent system concept is the CPC Aqua System from Germany that works without antifreeze and can easily be adopted to a conventional heating system. The existing heating system can easily be extended by a solar thermal system as the

collector can be integrated in the auxiliary heating circuit. The existing hot water store has not to be exchanged by a special solar store, as the heating fluid in the collector circuit is simple heating water and no special antifreeze-fluid is needed.

Another German solar domestic hot water system is the SECUSOL system. This drainback system consists of an all-in-one-package with integrated pump and solar station. It is developed especially for Southern European climate conditions and has the advantage of simple installation and low price.

The third German system concept (auroCOMPACT) is a solar domestic hot water system with an interesting store concept. It consists of a solar and gas combination, where the gas burner for auxiliary heating is directly integrated in the store. All appliances are integrated in one single casing, so that only the external parts like collector, radiator etc. have to be connected. This reduces installation effort and makes the system easy to handle and to repair as all parts can be reached from the front.

Northern European countries like Norway, Sweden and Denmark work in a common project for competitive solar heating systems for residential buildings (REBUS) [2]. In this context a concept for a competitive solar combisystem (SCS) was developed in Sweden by SERC, which combines the use of solar and wood pellets. Especially for Sweden the system concept is very interesting, as pellets are very cheap there. As the REBUS project aims to make installation of SCS easier, a technical unit was developed where everything is included. The advantage is that this module of 60 cm x 60 cm is very small. For realisation of solar space heating another 60 cm x 60 cm unit that includes the solar store is needed.

In the context of the REBUS project a similar system was developed in Denmark by DTU. It also consists of 60 x 60 cabinets, but auxiliary heating is realised with a condensing gas boiler. The unit is pre-fabricated and pumps, heat exchangers, expansion vessel etc. are integrated, so that easy and fast installation is possible. Other advantages of the system: The solar thermal system can be added later as the technical unit can be operated without the solar tank. High flexibility is guaranteed as different condensing gas boilers can be used, the technical unit can be applied for small and large solar combisystems (SCS) and the system is based on one single controller for solar, boiler, domestic hot water (DHW) and space heating (SH).

Norway introduced an installation-friendly polymer collector with very low weight in combination with a drainback system, where pure water as heat carrier is used.

One innovative product was identified in Holland: A solar ridge of Eko-Nok. On the top of the roof a single tube is situated with heat pipe boiling-condensing principle. As in Holland hot water stores are normally installed directly beneath the roof heat losses are very small.

In Southern European countries like Spain, Portugal, Italy or Greece mainly thermosyphon systems are of interest.

In the next step the selected system types will be further evaluated on site. Finally the systems will be presented with regard to efficiency, ecological and installation

aspects as well as costs. All collected experiences will be taken to compile design and installation guidelines for the new system generation and will be made available for industry. Workshops with industry participants will be arranged in order to discuss the results and to derive general recommendations for future system development.

WP 2: Standardised system concepts

Up to now the predominant solar system is installed in private houses with mainly small collector areas. In any case, for reaching the goal of the EC white paper with 100 Mio m² solar thermal collectors installed until the year 2010 a “break through” also in the field of large solar thermal systems for multifamily houses which are located mainly in urban areas is necessary.

The work in NEGST WP2 is meant to point out and overcome the barriers that hinder the dissemination of such large solar systems for the hot water supply in large buildings.

While there is already a wide product range of standardised products offered by the industry for solar hot water preparation systems and also in combination with space heating, standardised solar systems for multi family houses and hotels are not available up to now.

The fact that large systems are generally as or even more economic as systems for single family houses raises the question why large systems are not a common part of today’s technology? Beside this technical issue, the decision process for large solar systems needs a more systematic approach than for a small private system.

Beside the lack of standardised components and system technology, a more challenging planning and construction is needed.

As a step towards a higher level of standardisation and systematic approach for large systems, a detailed questionnaire for planners, solar manufacturers, and the building industry was developed within the NEGST project and sent out to a clearly defined target group. The aim is to get feedback about the experiences and major barriers for the implementation of large solar thermal systems. For further discussion and consolidation of the results, national workshops with the target groups will be arranged in at least three European countries.

For easier installation and reduced costs the possibilities for the standardisation of components applied in large solar systems are determined. Amongst the NEGST partner countries a survey of applicable financing models (e.g. energy contracting) is performed.

NEGST is finally aiming at delivering applicable recommendations regarding the use of solar components, system technology and financial issues. Moreover, best practise models will be compiled. Those hopefully will show ways to break down some of the barriers that oppose the broad dissemination of large solar thermal systems in Europe. The essence of the achieved results will be the basis for marketing material aiming at investors and the building industry.

WP 3: Integration into buildings

In this work package pre-normative work on uniform methodologies to fully integrate solar heating systems in the building envelope is done. For this reason an inventory of existing requirements and directives in EU countries has been compiled concerning topics like strength of construction (wind/snow), avoidance of fire risk,

noise problems, construction damage, air leakages/thermal bridges, environmentally problematical materials, rain and moisture penetration, water tightness and maintenance of the roof. This inventory includes more than 150 regulations, guidelines and national standards concerning building integration from Austria, France, Germany, The Netherlands, Norway, Portugal and Sweden.

Further steps are to find gaps in knowledge and regulations, to find solutions and to give recommendations for uniform European requirements. One example of existing problems which is not covered by standards is the glass cover for façade collectors: 6 mm glass has to be used instead of the standard of 4 mm. But does the profile of the collector frame support thicker glass covers?

In addition the work package aims to disseminate efficient methods and innovative ways of integrating solar thermal technology with a focus on architectural and aesthetic points of view in new and existing buildings. Recommendations will be given for the development of easily installable products and for integration in conventional heating appliances including wood pellet burners.

WP 4: Towards the next generation of standards

This work package has the objective to complete pre-normative work for a next generation of solar thermal systems and components. These new standards are needed to help new and better products, which are not covered by the existing standards, to penetrate the market as soon as possible. The interim results and the work of this extensive work package are presented in a separate paper [3]. One of the results in this work package was the “conversion from m^2 to W_{th} ”. Traditionally solar thermal installations have been accounted in square meters of collector area, a unit not comparable with other energy sources. Therefore a methodology was developed to convert installed collector area into solar thermal capacity.

WP 5: Advanced applications

Specifically this work package aims to assess the potential of solar collectors for advanced applications, such as cooling and desalination. The extension of the utilization field is a measure that can not be disregarded with respect to facilitating further penetration of solar thermal systems and to stimulate the production of innovative concepts. The application of solar collectors for air conditioning or general production of chilled water can have a high potential. In fact, even though in many southern locations the heating load is still greater than the cooling load, the period of utilization of the solar system is wider. The explanation is that the cooling cycle can be reversible or, in any case, the collectors can be directly used for heating purposes during the cold season, while the opposite process is not possible without the presence of the cooling machine. A second potential application in southern regions is represented by the desalination of seawater, which can be particularly valuable in isolated areas, where the supply of fresh water with traditional means is usually very onerous.

Multiple technologies can be found for seawater desalination and solar cooling systems. The main objective of this work package is to identify the most promising technologies powered by solar thermal energy with regard to effective future developments.

A technical status report on the different solar cooling and desalination technologies has been compiled. This report comprises an overview on all cooling and desalination systems which can be in principle coupled with low to medium temperature solar collectors. It will be the basis for the analysis of the suitability of different collector technologies for solar cooling and solar desalination. A feasibility study will be carried out in order to identify potential application areas in European countries. The next step will be the development of a user-friendly design and simulation software for the promotion of these technologies and the organisation of workshops for knowledge transfer.

WP 6: Project Management

The last work package comprises management and coordination of the whole project in order to achieve the contractual obligations and expected results. Another task is to disseminate the results achieved within the project.

Up to now the following activities concerning marketing and public relations have been carried out:

- Project website
A website www.swt-technologie.de/html/negst.html with general information on the project as well as the current activities in the individual work packages was designed. This site is regularly updated with the latest working results. On this site all publications and reports mentioned above will be made available for the public.
- Newsletter
The first project newsletter was published in September 2004 where industry was requested to deliver input and collaborate for the tasks included in WP 1. The second newsletter will be issued in combination with the estec2005 conference in June 2005.
- Press releases
A first press release is available on the website in seven different languages. It is planned to publish such press releases on a regular basis to inform public and industry about the work progress.

Outlook

The NEGST project offers the opportunity for industry and research institutes to exchange their knowledge and experiences. It represents a suitable instrument to closely work together on an European basis and to overcome market barriers by the creation of uniform regulations and standards that are valid in all European countries. Furthermore it forms the framework for the development of a new generation of solar thermal systems.

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Next Generation of Standards

New Generation of Solar Thermal Systems (NEGST) – Work Package 4

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Introduction

By nature, standards are always developed with a certain time delay compared with developments of products and systems. This delay may often be a barrier for the new products to enter the market, as no testing and certification is possible or existing standards do not express the benefits of the new products.

The aim of the pre-normative work described here is to minimize time delay between product development and market entry – in other words: To assist in removing market barriers for new (and better) products.

The methodology of the work is to:

- agree on priorities for urgent needs for standards concerning test methods and requirements
- exchange of experience and know-how in testing and test methods for new and advanced systems, components and applications
- work towards a common European approach on testing and standardisation
- validate test methods and do inter-lab comparisons
- pass on to CEN/TC312 requests as a basis for initiating standardisation in those fields which have urgent needs

The specific fields in which new and/or updated common European standards/specifications may be needed at the same time define the vertical oriented subtasks:

1. Collectors
2. Stores
3. Controllers
4. Combi-systems
5. Cooling
6. Solar thermal / Heat pump
7. Desalination
8. Fluids
9. Life Cycle Assessment (LCA)
10. m² -> Power & Energy¹

In the following the work done and decisions taken is reported subtask by subtask. Common for the decisions taken in subtask 1-8 is that they are based on:

¹ Converting installed collector area into installed power capacity and annual energy production

- reactions to questionnaires sent out to industry and other potential interested parties late 2004 early 2005
- work shop held with industry (in connection with ESTIF GA in November 2004)
- discussions within the project group at Kick-off meeting and 2. project meeting

The work is part² of the ongoing EU project “New Generation of Solar Thermal Systems, NEGST” [1,2]. More detailed information on this specific work package 4 is available from [3].

Subtask 1. Collectors

Concerning collectors work will be done in the following areas:

Collector components – requirements and test methods

So far only EN standards for the whole collector “unit” exist. This does not match today’s “production reality” where the components often are mass produced at specialized factories for: absorber strips; selective absorber surfaces; glass; anti-reflective coating of glass, etc. The trend at the moment is that production gets more and more specialised.

The following collector “components” relevant for studying more in detail the need for standards for requirements and test methods were identified:

- absorbers (made of polymer)
- absorber surfaces/coating
- covers (made of polymer)
- reflectors
- AR-coating³

This work is expected to lead to a proposal to CEN TC312 for a new “Work Item”: “Collector components – requirements and test methods”.

Air-collectors

The use of air-collectors is seen as a rather interesting option, especially in future systems providing both heating and air-conditioning. No EN standards are available for air-collectors, however substantially work has been done within ISO TC180, and it might be a matter of simply taking over (or referring to) ISO standards, or maybe some adjustments has to be made. The result here will be a “resource document” describing the situation and giving recommendations to CEN TC312 concerning air-collectors.

Tracking collectors

The use of tracking (focusing) collectors is expected to increase due to new applications such as desalination, cooling and process heat. Experts and test institutes did not yet agree if the existing standard EN12975-2 is in fact applicable to tracking collectors. Clarification/agreement of this will be the result, shortly documented in a “resource document”.

² Work Package 4: “Towards next generation of standards”

³ AR = anti-reflective

Improved qualification tests

One of the main difficulties in having the European standard EN12975 accepted in all member states without additional requirements has been - and is still – different opinions about whether the exposure test method now included in the standard gives a correct indication of collector quality/lifetime. Improvements of this test will be discussed and the aim is to present a revised test procedure agreed upon amongst test institutes and industry. This work shall and will be coordinated with the work in “Collector components”.

Requirements and test method for mechanical load on vacuum tube collectors are missing in the existing standard – a draft proposal will be developed.

Improved performance testing

Resource documents with recommendations for improvements of the accuracy and repeatability of the performance test will be made for covered/un-covered collectors.

Subtask 2. Stores

External heat exchangers

The most urgent need was agreed to be: Test method(s) for stores with external heat exchangers. This will help judging the (cost effective) solutions/systems using conventional water tanks. Draft test procedure will be developed.

Rational/flexible development of new store testing methods

As a number of new types of stores are expected on the market in the coming years it was decided to study basic principles/concepts to be applied in the development of new store test methods in order to have in the future a concept ready to quickly give new test methods. Outcome: Resource document.

Improved parameter identification

Work will be done to improve and rationalise the parameter identification method used for store testing including aspects of validation. Recommendations for revising existing method will be given in “draft revised test procedure” .

Subtask 3. Controllers

Variable flow controllers

Draft test procedure will be developed for controllers able to control also the flow rate (for e.g. keeping collector outlet temperature constant).

Energy consumption of pumps and controllers

Draft test procedure will be developed for controllers able to control also the flow rate (for e.g. keeping collector outlet temperature constant).

Subtask 4. Combi-systems

Integrated burner

Experience from testing combi-systems (stores) with integrated burner will be reported and recommendations given.

Performance calculation

A simple calculation method for combi-systems is needed e.g. in connection with the implementation of Energy Performance in Buildings Directive (EPBD). A draft method will be put up.

Update DC test method

The Direct Characterisation performance test method developed in IEA Task 26 and Altener "Combi- System" project will be updated. New draft test procedure will be made.

Comparison of performance test methods

The different performance test methods:

- Direct Characterisation, DC
- Component Testing and System Simulation, CTSS

proposed from different parties will be compared by Round Robin testing. Work and conclusion will be reported in a Resource document.

Subtask 5. Cooling

Survey on existing software

Survey on existing software for simulation/calculation of solar assisted air-conditioning systems will be done and reported in a resource document.

Survey on existing A/C component test methods

Survey on existing test methods and standards for air-conditioning (A/C) component will be done and "interface" with solar test methods will be investigated. To be reported in a resource document.

Control systems

Investigation/survey of controllers for solar assisted A/C systems. Resource document.

Subtask 6. Solar thermal / heat pump

It was decided not to give this field priority for the time being.

Subtask 7. Desalination

Materials – corrosion issues

Guidelines for materials compatibility (corrosion issues) will be put up, with the purpose of proposing to CEN TC312 to publish a TR/TS on this issue based on this document.

Performance testing

Guidelines for performance testing of solar systems with desalination units will be developed again at a TR/TS on this issue.

Basic document(s)

Basic investigations in solar desalination systems will be reported in a resource document.

Subtask 8. Fluids

Standard for solar thermal fluids

The aim here is to come up with a proposal to CEN TC312 for a new "Work Item":

- "Fluids for solar thermal systems – requirements and test methods". The work to be done is:

Putting up recommendations for test methods and standards for determination of fluid parameters.

Setting draft work plan for the elaboration of requirements and testing methods for fluid life / deterioration.

Subtask 9. LCA

Guidelines for LCA-rating of Solar collectors

A comprehensive literature survey has been done. Based on this and discussion with project participants and industry, guidelines for (simple) life cycle assessment rating will be developed and proposed as a basis for a CEN TR/TS. At the moment a lively discussion is going on whether the rating will be based on energy payback time and/or other parameters. Final decision is to be taken during the next few months.

Subtask 10. m² → Power and Energy

Background and guidelines for converting installed collector surface in m² to installed capacity in power (W) and to estimated annual energy production (J) will be made.

Conversion of m² to power

Traditionally installed solar thermal capacity has been counted in number of m². This has made it difficult to compare with other energy technologies counting their capacity in kW. A simple formula for converting installed capacity counted m² to installed capacity counted in kW has already been proposed:

- $P = 0.7 \text{ kW/m}^2 * A$, P in kW, A in m²

This conversion concept has been very well received by industry and others (including IEA-SHC) and is already being used of ESTIF in press releases and articles (see e.g. [4].)

Conversion of m² to energy

It is of course in the end the (annual) energy production which counts, so this is parameter giving the best figure for the capacity of the energy technology. The aim is to come up also here with simple formulas/guidelines for converting installed m² and installed power into estimated annual production.

Project participants

The NEGST project - funded by the EU 6th Framework Programme - is co-ordinated by University of Stuttgart, Institut für Thermodynamik und Wärmetechnik (ITW), Germany. Task leader of WP4 is the European Solar Thermal Industry Federation, ESTIF - assisted by SolarKey Int. The project participants and contact persons are listed at <http://www.swt-technologie.de/html/participants.html>.

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- [1] Drück, H. et al: *New Generation of Solar Thermal Systems – an EU Project*, Proceedings of estec2005 conference
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