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TASK 54

Newsletter 2017

IEA SHC Task 54 is dedicated to the price reduction of solar thermal systems up to 40%. Simplified systems and easy-to-install components are investigated alongside innovative and cost-efficient materials, processing and manufacturing techniques, marketing strategies and distribution channels.

In this newsletter

Progress in the development of heat pipe collectors for overheating prevention

Solar domestic hot water system with polymer inlet stratifier

The fourth experts meeting took place in **Rapperswil, Switzerland** (May 3-4, 2017), and was hosted by HSR-SPF. The fifth experts meeting, which included a Public Workshop and an Industry Round Table, was held in in **Linz, Austria** (Oct 4-6, 2017) at the Johannes Kepler University. The events were visited by 25-30 participants from industry and research, providing valuable insights into ongoing cost activities.

Task 54 Experts in Rapperswil, Switzerland (May 3-4, 2017)

Task 54 workshop and industry round table in Linz, Austria

Cost reduction potentials by material substitution and polymeric alternatives were in the focus of this year's public dissemination workshop in Austria. On Oct 4, 2017 around 50 guests from the Austrian renewables sector and partners from neighbour countries joined the national dissemination workshop hosted by the Johannes Kepler University in Linz. They were informed on the latest developments in the research on cost-efficient alternatives to standard materials, e.g. polyolefin based components for pumped systems or polypropylene for non-pumped systems. Collector manufacturers GreenOneTec, Aventa and Sunlumo provided insights in their latest product innovations. Research partners from the University of Linz and AEE INTEC informed about technical boundary conditions. How these innovations can be evaluated in terms of cost reduction was the topic of the closing session on Task 54's LCOH calculation method and its application to novel system concepts. The presentations of the Linz workshop are available online.

Image: Workshop in Linz, Austria on Oct 5, 2017

Industry Round Table

The public workshop was followed by an industry round table on the next day. It was directed at a small expert circle from the solar thermal industry who was invited to assess Task 54 innovations from an economic point of view. Short summaries on results in all Task 54 Subtasks and a guest lecture by Roger Hackstock (Austrian Solar) and Dr. Gerhard Rimpler (my-PV GmbH) were followed by a discussion on the viability of Task 54 findings and additional ways to strengthen the competitiveness of solar thermal. Next to technical innovations on component and material level, potential was seen in new system approaches or novel investment models. Solar thermal should not only be worthwhile for private house owners, but also for investment companies. The experts further strengthened Task 54’s assumption that solar thermal not only lacks competitive prices, but also competitive image amongst the renewables. Dedicated PR measures and awareness raising activities could contribute to polishing the image of solar hot water preparation.

Image: Industry Round Table in Linz, Austria on Oct 5, 2017

By Sandrin Saile, Fraunhofer ISE, Germany | sandrin.saile@ise.fraunhofer.de

Towards new system solutions with solar thermal – Insights by Roger Hackstock, Austria Solar

A special impulse to Task 54's Industry Round Table on Oct 5, 2017 was given by Roger Hackstock. As Managing Director of the Austrian solar thermal association Austria Solar, book author and former programme manager for Austrian Climate and Energy Fund, he has witnessed the solar thermal market for years and seen the challenges solar heat is facing from multiple angles.

Image: Roger Hackstock

In order to secure solar thermal a steady place in the future energy mix he calls for a change in mentality on the side of solar thermal companies, which might have to rethink established ways of approaching customers by innovative distribution channels or digital solutions. In addition, they might think of integrated system solutions in which solar thermal can take up an economically and ecologically beneficial role.

Three of these system solutions were presented during the Industry Round Table. As first step towards new system approaches, Hackstock suggests solar heating systems with solar system as main heating and a heating rod as auxiliary heating. This would be feasible in low energy buildings with 70% solar capacity. A second way to think solar thermal, according to Hackstock, is via integration in district heating networks. "With large scale installations above 5.000 m² solar thermal can provide heat at lower than 5 Cent/kWh", Hackstock explains the benefits of this variant. A very good example of successful integration of solar heat into district heating is shown by the Austrian city of Graz where a solar field of 450.00 m² reaches a solar fraction of about 20% and could be best practice example for cities of the future. Thirdly, one should not refrain from thinking solar thermal in combination with other renewables, e.g. clever combinations with heat pump, ground storage or smart control systems could significantly lower system prices and might be another way to strengthen solar thermal.

Roger Hackstock's vision on a sustainable integration of solar thermal in the future energy system and its place in the energy transition is summarised in his latest publication *Flexibel und frei – Wie eine umfassende Energiewende unser Leben verändert, published by oekom verlag*

in 2017. ISBN-13: 978-3-96006-017-8.

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LCOH calculations of a selected reference system & sensitivity analysis

To analyse the influence of different measures to increase the overall efficiency of the German solar reference system on the levelized cost of heat (LCoH), a sensitivity study was carried out. The results are shown in the table as relative values for the initial investment and the LCoH and as absolute figures for the saved energy in comparison to the solar reference system for domestic hot water.

Reference system/ changes	Initial investment [%]	saved fuel [kWh/a]	LCoH [%]
Reference system	100	2226	100
Heat trap at hot water outlet	101	2337	96
Storage efficiency label „B“	104	2539	91
Storage efficiency label „A“	107	2641	88
More efficient collector	103	2508	90
Storage efficiency label „B“ + more efficient collector	106	2818	82
Storage efficiency label „B“ + more efficient collector + extended service time (25 years)	106	2818	72

Table: Initial investment, saved fuel and resulting LCoH of different system modifications on the basis of a German domestic hot water system

Although all measures increase the initial investment slightly a much larger impact can be seen on the LCoH. E.g. the use of a more efficient collector and hot water store results in a decrease of 18 % of the LOcH. These measures together with an increase of the service time from 20 to 25 years would even result in a reduction of the LCoH of 28 %.

It can be summarised that not only the reduction of the initial cost but also the increase of the performance of the system can result in a significant cost reduction. More Information on LCoH calculation and first results for reference systems are available as info sheets.

By Stephan Fischer, University of Stuttgart, Germany | fischer@itw.uni-stuttgart.de

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First proposals for standardisation (collector / storage)

Within the German Project KoST (Cost reduction in solar heat by standardised components and interfaces) funded by the Federal Ministry of Economic Affairs and Energy first proposals for a standardised flat plate collector and a solar hot water store were proposed. The proposal was elaborated by the Institute for Thermodynamics and Thermal Engineering (ITW), the Fraunhofer ISE and the 8 participating manufactures of solar thermal products from Austria, Germany and Switzerland. It is based on market studies of components within these three countries, taking into account the market penetration and thermal performance.

Proposal standardised flat plate collector

Dimensions:

- Gross Area = 2.60 m² (size is well known and manageable by installers)
- Width = 1300 mm (use of max. absorber plate width (1250 mm) is possible, no cutting of the absorber necessary, lowest cost for the absorber plate)
- Length = 2000 mm (results from the area and width, best utilization of the raw glass plate)
- Thickness = 80 mm (material savings for the frame and good collector output are possible)

Connections:

- 4 (highest flexibility in installation)
- 18 mm header (highest market penetration, less material than 22 mm)
- Pluggable (installation friendly)

Immersion Sleeve Temperature Sensor:

- None, to be integrated in pluggable connection

Connection to Mounting System:

- Peripheral groove (highest market penetration)

Proposal standardised solar hot water store

Requirements:

- 300 l volume, dimensions such that it can be moved through standard doors without problems
- Energy efficiency label „B“ according to Regulation (EU) Nr. 812/2013, Annex II
- Insulation in PU-foam
- Heat traps for the following connections: hot water, auxiliary flow and return, collector flow.

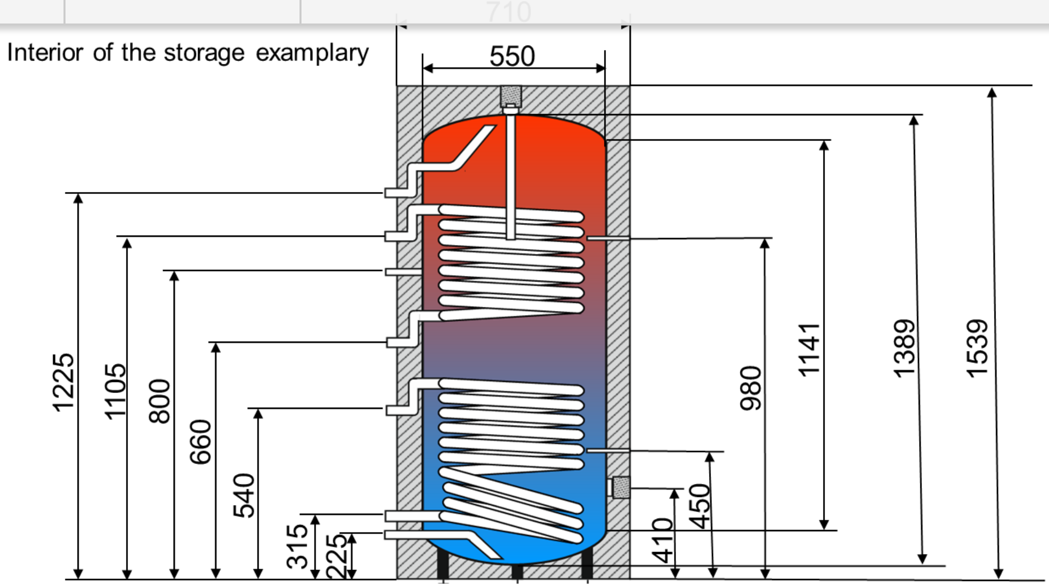

Image: First proposal for a standardised solar hot water store

The proposal of standardised flat plate collector and hot water stores aims at a simple installation resulting in lower installation costs and lower technical risks.

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Price reduction potential Switzerland

The potential to reduce market prices for turn-key domestic solar thermal systems in Switzerland was recently analysed within a study financed by the Swiss Federal Office of Energy. The study focussed on the cost effect of new technological approaches, regarding single components and the whole system. Based on a market survey for single- and multi-family buildings, the cost structure of actual offers for solar thermal systems in existing buildings in Switzerland was analysed. Relevant cost drivers were identified and strategies for implementing new and cheaper technologies were proposed and their possible effect on the market prices were quantified.

As a key result the study shows the importance of mechanisms that keep the temperatures in the hydraulic system at a level which allows for using plastic materials. This means high temperatures above around 100 °C have to be avoided at least in all system parts except the solar collectors. This temperature limitation can be realised either with new collector concepts that do not generate or emit temperatures above 100 °C, or with system concepts that guarantee a retention of high temperatures in the collectors (e.g. drain back systems). With this temperature limitation low-priced hydraulic components from the heating mass-market can be used.

For solar systems with pressurised hydraulic loop, polymeric pipes, polymeric storage, and collectors with overheating protection a market price reduction of 21 % was found. A larger reduction of 25 % could be reached with water-drain back systems that use polymeric pipes and storages. Further cost drivers in the organisational field were found, which could increase the total price reduction up to 39 %.

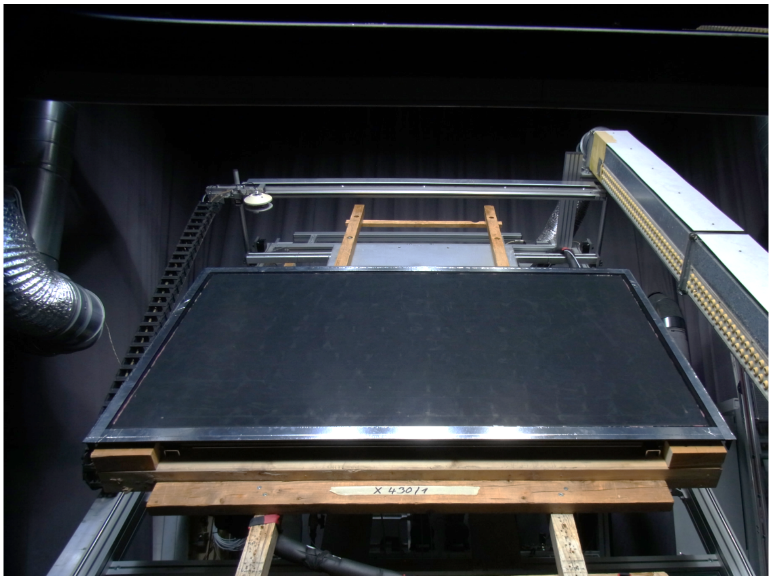

Image: Solar collector with overheating protection

By Daniel Philippen, SPF Institut für Solartechnik, Switzerland | Daniel.Philippen@spf.ch

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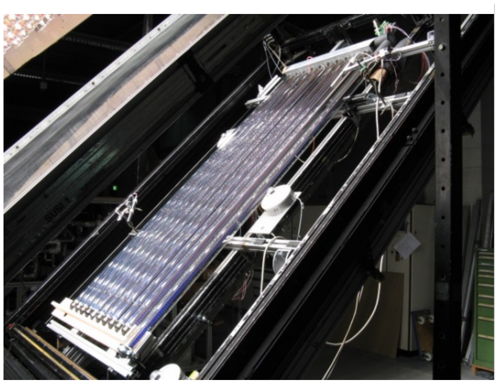
Progress in the development of heat pipe collectors for overheating prevention

Solar collectors with heat pipes offer the advantage of an easier hydraulic connection to the solar circuit compared to direct flow collectors, a lower pressure drop and the possibility to protect the system from overheating during stagnation periods. The use of optimised heat pipes both in evacuated tube collectors (ETC) and flat plate collectors (FPC) can lead to simpler and more reliable systems, thus representing a promising approach for cost reduction. The potential of this technology as well as the corresponding technical and economic benefits are currently being investigated in the project HP-KOLL.



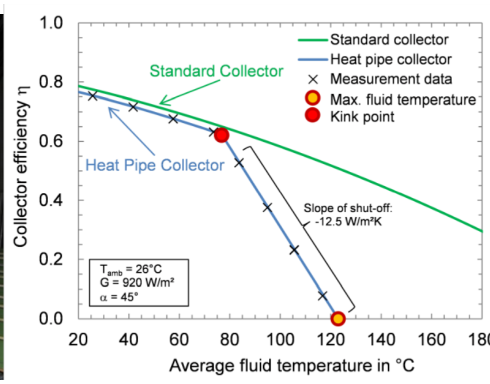


Image: Evacuated tube collector prototype with heat pipes during the indoor performance measurement (left) and its measured efficiency curve with power shut-off (maximum fluid temperature of 125°C) compared to a standard collector (maximum fluid temperature of about 250°C) (right)

On the basis of our previous theoretical and experimental works, we have developed and comprehensively analysed an ETC with novel heat pipes. The performance is comparable to standard collectors whereby the maximum temperature in the solar circuit is limited to 125 °C during stagnation periods. Consequently vapor formation in the solar circuit can be completely avoided and thermomechanical loads are significantly reduced. The same overheating protection is also implemented in a novel FPC. The experimental investigations will be terminated before the end of 2017.

The costs of the new collectors are expected to be comparable to those of commercially available products by selecting appropriate materials (i.e. aluminum heat pipes for FPC) and by implementing optimised manufacturing processes and designs. As consequence of the temperature limitation system components such as the expansion vessel or the solar piping can be resized or made of cheaper polymeric materials, the installation procedure can be easier and the maintenance effort is much lower. Thus, the estimated cost reduction of a typical domestic hot water system with heat pipe ETC ranges between 20 and 30 % compared to a similar standard system. For FPC-systems the levelized costs of heat (LCoH) according to the IEA TASK 54 calculation can be reduced by 27 – 35 %.

The project is funded by the German Federal Ministry of Economy and Energy (reference number 0325550A-C) and carried out by the companies KBB Kollektorbau GmbH and Narva Lichtquellen & Co. KG, in cooperation with the Institut für Solarenergieforschung Hameln (ISFH).

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Solar domestic hot water system with polymer inlet stratifier

To improve the cost efficiency of small solar domestic hot water systems, standard hot water tanks with inlet stratifiers can be used as heat stores of the systems.

The inlet stratifiers can enhance thermal stratification in the heat stores, thus increasing the thermal performance of the solar heating systems. Side-by-side tests of two small solar domestic hot water systems have been carried out in a laboratory test facility for solar heating systems. The systems are identical with exception of the heat storages. One system is equipped with a traditional solar hot water tank using a built in heat exchanger spiral and one system is equipped with a standard hot water tank using a polymer inlet stratifier produced by EyeCular Technologies, www.eyecular.com.

The investigations showed that the system with a standard hot water tank with the inlet stratifier has a yearly thermal performance and a performance/cost ratio which is 8% respectively 5% higher compared to the traditional system.

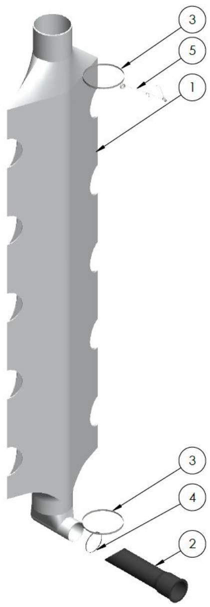

Image: Polymer inlet stratifier from EyeCular Technologies

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For more information please see our:

Info Sheets

Publications

Upcoming Events

6th Experts Meeting, Apr 24-25, 2018
Sophia Antipolis, France

National Dissemination Workshop, Apr 26, 2018
Sophia Antipolis, France

Symposium Thermische Solarenergie, June 13-15, 2018
Kloster Banz, Bad Staffelstein, Germany

ECOS 2018 - 31st International Conference on Efficiency, Cost, Optimisation, Simulation

and Environmental Impact of Energy Systems, June 17-22, 2018
Guimarães, Portugal

Intersolar, June 20-22, 2018
Munich, Germany

EuroSun 2018, Sept 10-13, 2018
HSR-SPF, Rapperswil, Switzerland

ISEC 2018 - International Sustainable Energy Conference, Oct 3-5, 2018
Graz, Austria

More information:
http://task54.iea-shc.org/meetings

SOLAR HEATING & COOLING PROGRAMME
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Price reduction of solar thermal systems up to 40% by research along the value chain.

For more information please visit our homepage:
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