SOLAR UPDATE

VOL. 68 | DECEMBER 2018

Newsletter of the International Energy Agency Solar Heating and Cooling Programme

SHC INTERNATIONAL ENERGY AGENCY Solar Heating & Cooling Programme

iea Energy Technology Network

#SolarHeat
#SolarThermal
#SolarProcessHeat
#SolarCooling
#SolarDistrictHeating

In This Issue

www.iea-shc.org

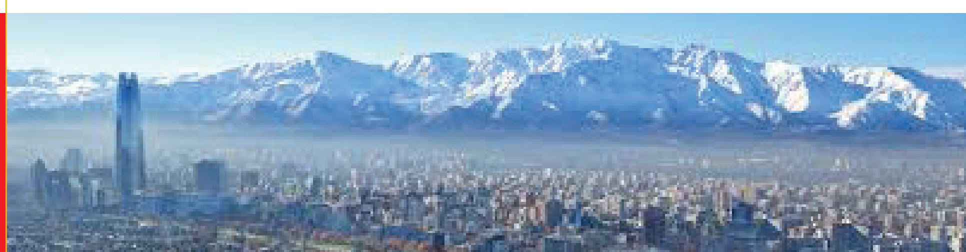
SHC 2019 and SWC 2019 Join Forces Again to Offer the 'Must Attend" Solar Event of 2019

ISES SWC 2019

SHC 2019 will be held together with the ISES Solar World Congress (SWC 2019) for the second time. By joining these two conferences, you will find in one place the most up-to-date information on renewable energy technology trends and breakthroughs, global and regional policies, and market opportunities. SHC 2019 will focus on the latest developments in solar heating and cooling and recent market successes.

SHC 2019 is sure to inspire and motivate as you participate in the conference sessions and side events – workshops, technical tours, networking opportunities, etc. – as well as learn firsthand about the developments in Chile and other South American countries.

Our mission is to have you leave ready to help deploy solar thermal technologies as we push towards transforming energy systems and markets to 100% renewable energy.



The Call for Participation is Open!

Call for Papers Open until February 28

Find all the information you need at www.swc2019.org/call-for-participation.html

IMPORTANT DATES

Deadline for abstract submission	28 February 2019
Notification of authors	30 April 2019
Registration opens	30 April 2019
Deadline for full papers	31 July 2019
Early bird registration deadline	31 August 2019
Author registration deadline	31 August 2019

Save the Date

See you in Santiago, Chile November 4-7!

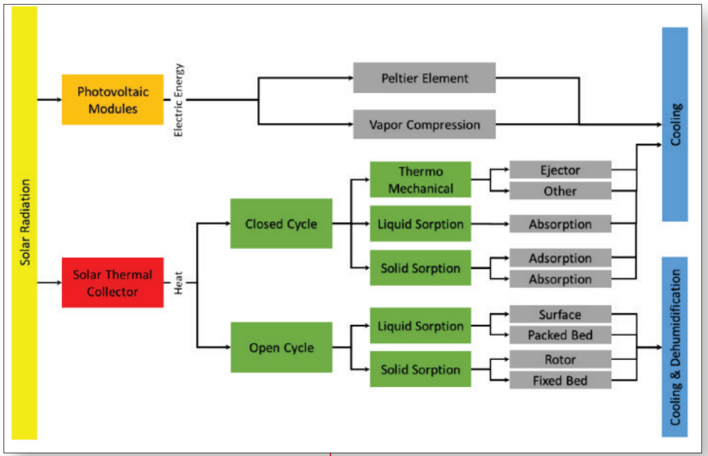
SHC Members

Australia
Austria
Belgium
Canada
China
Denmark
ECREEE
European Commission
European Copper Institute
France
Germany
ISES
Italy
Mexico
Netherlands
Norway
Portugal
RCREEE
Slovakia
South Africa
Spain
Sweden
Switzerland
Turkey
United Kingdom

Next Generation Solar Cooling & Heating Systems

You could say that cooling, is a hot issue. The stats in the new IEA report, The Future of Cooling (www.iea.org/futureofcooling/), speak for themselves…

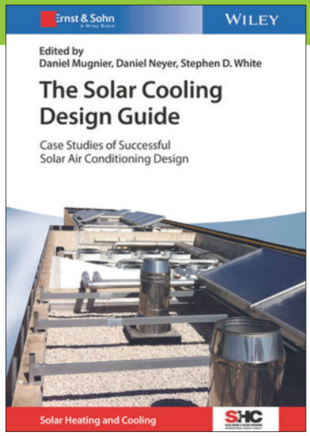
- *"Global energy demand from air conditioners is expected to triple by 2050, requiring new electricity capacity the equivalent to the combined electricity capacity of the United States, the EU, and Japan today."*
- *"The global stock of air conditioners in buildings will grow to 5.6 billion by 2050, up from 1.6 billion today – which amounts to 10 new ACs sold every second for the next 30 years."*
- *"Using air conditioners and electric fans to stay cool already accounts for about a fifth of the total electricity used in buildings around the world – or 10% of all global electricity consumption today."*
- *"AC use is expected to be the second-largest source of global electricity demand growth after the industry sector and the strongest driver for buildings by 2050."*



▲ **The latest generation of solar air conditioning systems comes in numerous configurations and powered by either solar heat or electricity. Some systems include storage tanks and can provide hot water or space heating in addition to space cooling.** Source: Henning et al. (2013) Solar Cooling Handbook

For the IEA SHC, we've long seen this ever-growing demand for cooling as an opportunity for solar technology and an area for international collaboration. Our most recent solar cooling Task is winding down. For the past four years, an international team of researchers worked on 1) solutions to make solar driven heating and cooling systems cost competitive and 2) building a sustainable and robust market for new innovative solar thermal and PV cooling systems. (Task's results continue to be posted on the Task webpage task53.iea-shc.org/). Both of these goals require methods for assessing and evaluating the technical and economic potential of the technology and benchmarking against conventional systems and different renewable technologies. Two tools developed to do just this are T53E4 and ELISA.

***The Solar Cooling Design Guide* is a compendium of case studies of successful solar air conditioning designs with over 100 illustrations in its 132 pages. To purchase your copy click here.**

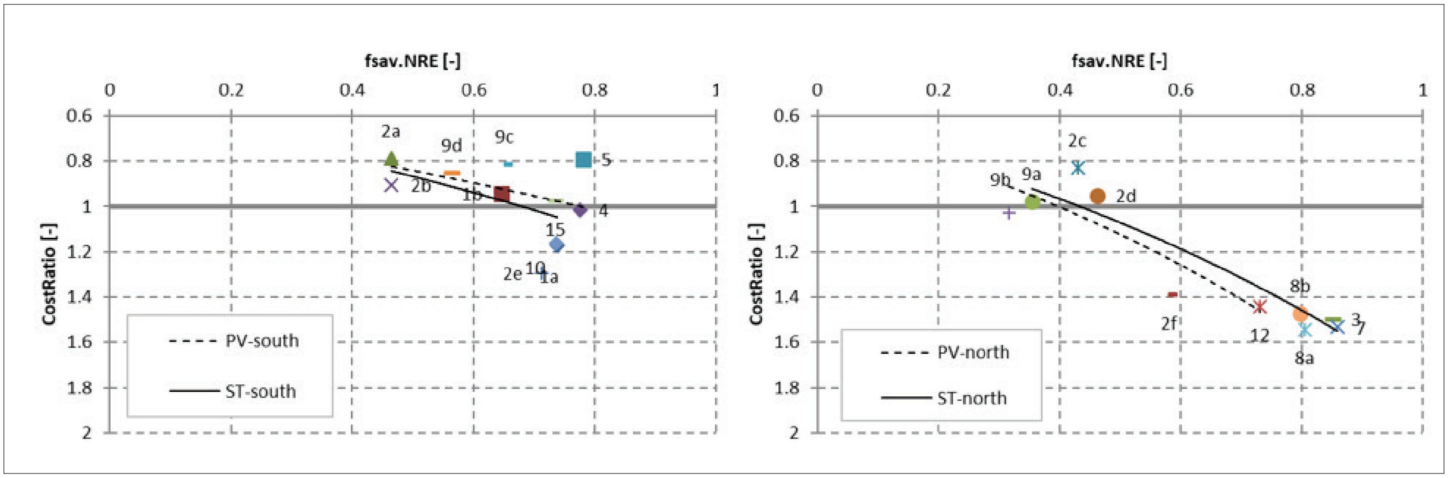


T53E4 Tool – To Assess a System's Technical and Economic Potential

T53E4, a technical and economic assessment tool, rates and benchmarks new developments at the system level (proper design and operation). This assessment tool provides a comprehensive database of boundary conditions that are used in various configurations and applications, which means that tool users can assess entirely different types of configurations. Users can obtain information on the efficiency and cost of a solar heating and cooling (SHC) installation and the reference system in a common comparable format. As part of this work, the Task researchers assessed and benchmarked 28 solar heating and cooling systems with the cooling capacity ranging from 5 kW to more than 150 kW.

The tool's reference system consists of a natural gas boiler and an air-cooled vapor compression chiller. All key results are provided in a normalized form. This means that a specific reference was selected to avoid a discussion about the absolute values and the right choice of boundary conditions.

continued on page 3



▲ **Results of analyses using the T53E4 tool: The cost ratio is shown on the y-axis over the non-renewable primary energy savings $f_{sav\ PER\text{-}NRE}$ on the x-axis. The graph on the left shows the configurations at southern sites, where cooling demand dominates over the summer. The graph on the right shows results from northern locations, where the need for cooling is lower during the same period.**

Two main parameters were calculated from the monthly energy balance of each configuration:

- *The non-renewable primary energy savings* ($f_{sav\ PER\text{-}NRE}$), which compares the non-renewable primary energy demand of an SHC system to those by a reference system. The fsav ranges from 0.3 to 0.94, which means that solar energy replaces 30% to 94% of non-renewable primary energy demand of the reference system.
- The *cost ratio* (CR) to describe the levelized cost of energy (LCOE) of an SHC system as opposed to the LCOE of a reference installation. The LCOE is derived from annuities paid over the lifetime of a system (typically 25 years). A CR below 1, such as 0.8, indicates that the solar device offers a 20% reduction in costs compared to the baseline, while a CR above 1, such as 1.4, describes a system that raises costs by 40%.

The configurations were then grouped by boundary conditions, for example, whether the location is in the south or north, and identified separate lines for solar heat and PV. Northern installations consist of those in Austria, Finland, Germany, Sweden, and Switzerland. Sites in the south are found in Italy, Spain, France, and China.

The southern locations depicted on the left graph below show promising results, with between 40% and 70% of energy savings at a total cost lower than that of the reference systems. This amount of saving is possible for both PV (see dotted line) and solar heat (see continuous line). If the industry could offer reduced system costs by only 15%, energy savings could be as high as 80% and the units would be cost competitive in southern locations.

The cooling systems in northern locations, where there is less demand for air conditioning (graph on the right-hand side above), paint an entirely different picture. Only if primary energy savings are kept to 40% systems can be cost-competitive to references. Aiming for savings of between 60% and 80% will increase costs tremendously. Again, it is the investment that had the strongest impact of all parameters. If investment costs are reduced by at least 30%, cost-effectiveness could be guaranteed along the entire trendline.

What this tool shows is that cost-competitive solar cooling configurations are possible even with today's investment cost models. And, that solar technologies can be optimized for solar heating and cooling. Whether solar thermal or PV is the more favorable option will mostly depend on the location and the design of the system.

ELISA Tool

Another Excel-based tool is the Environmental Life Cycle Impacts of Solar Air-conditioning Systems (ELISA). This user-friendly Life Cycle Assessment (LCA) tool can assist researchers, designers, and decisionmakers in evaluating the life cycle energy and environmental advantages for solar cooling systems in place of conventional ones. This easy to use tool, designed for educational and research activities, takes into consideration specific climatic conditions and building loads.

ELISA was developed by the University of Palermo to carry out simplified LCAs and to compare SHC systems with conventional systems. It can:

continued on page 4

Next Gen Solar Cooling and Heating *from page 3*

- Be used for different geographic contexts
- Compare up to 4 typologies of systems:
  1. SHC system
  2. SHC system with photovoltaic panels (PVs)
  3. Conventional systems
  4. Conventional systems with PVs
- Calculate for:
  1. Global warming potential (GWP)
  2. Global energy requirement (GER)
  3. Energy payback time (EPT)
  4. GWP payback time (GWP-PT)
  5. Energy return ratio (ERR)

Both T53E4 and ELISA as well as many other reports will be available to download for free in January 2019 from the Task 53 website, http://task53.iea-shc.org/.

Daniel Mugnier of TESOL SA and Task 53 Operating Agent, Daniel Neyer of the University of Innsbruck in Austria and Task 53 expert, and Bärbel Epp of solarthermalworld.org contributed to this article.

GUIDING PRINCIPLES

From the lessons learned and experiences gained in SHC Task 53, the participants compiled a list of 10 guiding principles for solar cooling installations once steps are taken to reduce the current energy demand.

Principle 1
Choose applications where high annual solar utilization can be achieved

Principle 2
Keep the process flowsheet simple and compact

Principle 3
Use efficient heat rejection units/systems

Principle 4
Minimize auxiliary demand

Principle 5
Avoid using fossil fuels as a backup for thermal-driven systems (especially for single effect ab-/adsorption chillers)

Principle 6
Apply appropriate resources to designing, monitoring, and commissioning

Principle 7
Provide thermal storage capacity and hydraulics in a form that matches the thermal requirements of each energy demand

Principle 8
Minimize heat losses

Principle 9
Avoid over-dimensioning of the collectors

Principle 10
Design the ab-/adsorption chiller for relatively constant operation at near full load

INTERVIEW

New Generation Solar Cooling & Heating Systems

Interview with Daniel Mugnier

The IEA SHC Programme concluded its work on New Generation Solar Cooling & Heating Systems (Task 53) earlier this year and is now finalizing the last reports. To learn first-hand on how the Task supported the market development of the next generation of solar driven cooling and heating systems, we asked Daniel Mugnier, the Task Operating Agent, to share some of his thoughts on this 3-year project.

Why was this work needed?

Daniel Mugnier (Daniel): This Task on a new generation of solar cooling solutions was needed in 2014 because after the great work on quality insurance for solar air conditioning systems in SHC Task 48 (ending in 2012), this sector had important issues to address to become cost competitive even if the system quality and performance were already present. A new generation of systems had to emerge, and above all, we had to finally integrate solar photovoltaic driven solutions into the scope of work.

What were the benefits of running it as an IEA SHC Task?

Daniel: Solar Cooling is a hot topic (!) and cannot really be managed if just considered at a regional level (Europe for instance). As indicated in the recent report from the IEA called "Future of Cooling"[1], air conditioning is one of the major challenges in terms of energy consumption increases by 2050 worldwide

What, if any, results surprised you?

Daniel: In Task 53, we had the chance and the opportunity to list, study, model and measure innovative and commercially available systems based on this new generation. According to our cross analysis based on real measured values, it showed that solar thermally driven systems can be cost competitive with solar PV powered systems. Of course, economic efficiency depends a lot on the different criteria, but the game is still open between the different technological approaches.

If someone wanted to learn more, which reports should they read first, and why?

Daniel: The most important deliverables are:

- Those dealing with the state-of-the-art of this new generation of solar cooling systems in Subtask A, which is linked to the LCA (Life Cycle Analysis) approach thanks to a dedicated tool called ELISA to size the environmental impact of a system.
- In Subtask B, a very interesting report is the one on the results of simulations and system intercomparisons.
- But the most important report is from the work in Subtask C that is delivering real-life monitored results from nearly 15 installations of different sizes and types. The report "Monitoring Data Analysis on Technical Issues & on Performances" presents a comprehensive cross analysis both in technical and economic terms.

Do you have a Task success story from end-user or industry?

Daniel: One of the most exciting tools to be used by industry will be the ELISA tool that helps to calculate the different environmental indicators in terms of the life cycle analysis of commercialized systems. Designed by the University of Palermo, this tool is powerful even if needing detailed information to be provided by the industry actors themselves.

Another very interesting deliverable for end users, and above all, policymakers will be the Task 53 Position Paper which summarizes the main outputs from the Tasks, especially concerning cost competitiveness and level of maturity.

Has the Task's work supported capacity and skill building?

Daniel: Yes, definitely, we have informed several hundred people from different groups (installers in Italy, engineers in Spain, IEA SHC Solar Academy Webinar participants (more than 200 participants), policymakers in Cairo under the umbrella of League Arab States workshop, etc..) during workshops and special dedicated events on solar cooling (http://task53.iea-shc.org/meetings)

What is the current status of the technology?

Daniel: The technology is still under development and is profiting from the intensive stimulation work coming from the rapid cost decrease on the PV side. However, solar thermally driven solutions show interesting cost decreases as well, especially for large systems, as well as promising efficiency gains. Finally, there is nearly no significant market yet in term of volume (a few hundred new installations per year), but there are still numerous SMEs motivated and developing solutions based on solar thermal or solar PV approaches. The offer ranges from a few kWcooling to a few MWcooling.

continued on page 20

Building Experts at EuroSun 2018 Discuss What's Being Done and What Needs To Be Done

The 12th EuroSun International Conference on Solar Energy for Buildings and Industry was a big success. On September 10th to 13th, more than 130 oral and 180 poster presentations were given to an audience of researchers, professionals, and experts from all over the world in Rapperswil, Switzerland.

Key messages from the building experts' presentations highlighted how:

- The transition to a carbon-emissions-free society will move through buildings that are more electrified than today – future buildings will no longer act as consumers, but become prosumers thus minimizing the dependency on energy grids.
- Deeper integration of thermal and electric infrastructures are necessary.

AventaSolar's integrated solar thermal system on residential buildings.

Building envelopes represent a natural exploitable surface to "interact with" and to take advantage of the outdoor environment. Building Integrated (BI) Solar Envelope Systems, as demonstrated in IEA SHC Task 56: Building Integrated Solar Envelope Systems for HVAC and Lighting, reduce heating and cooling demands of buildings while controlling daylight and delivering renewable thermal or electric energy, or both to the systems providing heating, cooling, and ventilation to buildings.

At EuroSun 2018, many new technology developments were presented, but Photovoltaic Thermal (PVT) solar collectors took the spotlight. Despite the remarkable efforts over the past years, few commercial PVT products have succeeded in the market. Reasons for this gap between effort and success is a common stumbling block for solar thermal technologies – the complexity of the design and installation processes, lack of knowledge of stakeholders, aesthetic limitations and building regulation constraints, and lack of test procedures, to name the main ones. The good news is that change is happening and what's driving this change are a more favorable market and legislative conditions thanks to the definition of NZEB standards and building codes prescribing a minimum share of renewable energy production. Recent PVT solutions promote more compact and modular installations, the enhancement of thermal and electrical efficiencies by using low-e coatings and vacuum solutions, all combined with new aesthetically appealing solutions guaranteeing a better integration in the building envelope and visual acceptance.

New BI solar thermal developments that integrate thermal storage and collectors into façade solutions for domestic hot water preparation in residential applications were also presented at the conference.

From the four days of discussions, what emerged was that system integration is the ultimate factor for enhancing the competitiveness of solar technologies compared to conventional fossil fuel-based systems. Thanks to the type of actions noted above, PVT collector manufacturers are carving out a larger share of the market, but more work is needed on demonstrating the benefits of PVT applications. On-site energy production from BI solar thermal collectors has demonstrated its technical effectiveness through the years. Moreover, a large variety of system layouts have been developed and demonstrated, but the complexity of the hydraulic integration and high upfront costs have restrained market upscaling.

Building integration of solar technologies is one the most promising paths towards increasing energy efficiency and renewable energy sources in the construction sector. Despite this fact, it is hardly recognized as an added value by the market. The success of a technology on the market cannot be determined solely based on its optimum technical performance. Factors such as aesthetics, regulations, easy of design, installation and maintenance, economic sustainability, and co-benefits like better comfort and flexibility of building energy management must be accounted for and quantified.

To learn how SHC Task 56 is tackling these "other factors" visit our website at http://task56.iea-shc.org/.

This article was contributed by the Italian Task expert, Matteo D'Antoni of EURAC Research's Institute for Renewable Energy.

SHC Task 57

Solar Standards and Certification

As 2018 comes to an end so does our most recent Task on Solar Standards and Certification. SHC Task 57 built on the work of Task 43 on Solar Rating and Certification Procedures to develop, improve and promote ISO standards on test procedures and requirements for solar thermal products as well as to harmonize at the international level certification schemes. It is this harmonization work that sets this Task apart from our other work and the work begin carried out by other organizations. Task 57 participants leveraged the SHC platform of international collaboration to push a global certification initiative to improve the harmonization of certification schemes and avoid the need for re-testing and re-inspection of solar thermal products.

Introduction

There is a huge potential for saving resources for testing and certification if the same standards and certification procedures are used all over.

To highlight this potential, IEA SHC Task 57: Solar Standards and Certification gathered international experts within the field of testing, standardization and certification to work on harmonizing – at the international level - testing standards and certification schemes.

An important outcome of this work is the Global Solar Certification Network (GSCN), which is a network of industry, certification bodies, test labs and inspectors working together to ensure there is mutual acceptance of test and inspection reports from one certification scheme to another.

So far this concept of "re-using" test and inspection reports is in place for solar collectors, based on the newly updated collector test standard ISO 9806. And, plans are underway to expand it to include solar water heaters and other solar thermal systems and components. Task 57 experts have worked out new proposals for standards for compact solar water heaters, building integrated solar products and large collector fields. These will now be further processed and finalized in ISO/TC 180 – some of them for future use in GSCN.

To complement this work, guidelines for setting up certification schemes were produced and can be found at the Task website: http://task57.iea-shc.org/. These can be used in countries/regions where the market for solar water heaters is growing, and there are no or little quality assurance measures.

Cost Savings

Using the Global Solar Certification Concept

To illustrate the tremendous potential in savings using the GSCN concept for re-use of test and inspection reports is one of many different scenarios

A manufacturer selling 8 certified collectors in 3 different regions:

- Traditional Process: Testing and inspecting 8 collectors for 3 markets for each certification scheme would be a first-time expense of approximately 300,000 € plus the time required for the manufacturer employees to manage the processes.
- GSCN Process: Testing and inspecting 8 collectors only once means almost 2/3 of the 300,000 € can be saved.

  First year savings in this case around 200,000 €

  The following years' savings would be considerable too now that only 1 instead of 3 annual factory inspections are required.

Key Accomplishments

The Global Solar Certification Network (GSCN) established and operating

It is now possible to re-use test and inspection reports from Solar Keymark certification in Europe to SRCC certification in the USA – and vice versa. The first manufacturers are in the process of bringing their existing test and inspection reports to the new certification body to receive a certificate for the new market. A Chinese certification body has been approved too for participating, so soon three continents will be covered.

The number of members of the GSCN is growing – as of November 2018 there were 20 members and 10 applicants. These members include some of the world's leading collector manufacturers, some of the most active and important certification bodies and some of the most esteemed test labs. For updates on

continued on page 8

Certification *from page 7*

new members visit www.gscn.solar. On this website, you can also find the working rules and procedures for the GSCN, how to become a member, member fees and other information.

The ISO 9806 for collector testing updated

The recently updated ISO 9806 standard is widely accepted around the globe and is the basic testing standard for the Global Solar Certification Concept. To better understand this standard, Task 57 experts wrote a comprehensive guide to the standard that is available on the Task 57 website, http://task57.iea-shc.org/. This guide is a must-read for new (and existing) test labs as well as for manufacturers of solar collectors.

Four new proposals for ISO standards and new reports

Task 57 experts have prepared three final draft proposals to be proposed to ISO/TC 180:

- Test methods for mechanical load on support of **close-coupled solar water heating systems**
- Test methods for **close-coupled solar water heating systems** - Reliability and safety
- Test methods and requirements for **building integrated collectors and systems**

And, delivered a proposal for a new Work Item to ISO/TC 180

- Check of solar **collector field performance**

Other reports produced in Task 57 included:

- **Accelerated aging testing of collectors** that can be used as a basis for future standard test procedures for estimating collector lifetime.
- **Guidelines for implementing certification schemes** for solar systems and components in "new certification areas" that outlines the fundamentals of certification principles and proposes several levels of certification.

How to Ensure the Work Continues

The next step for the GSCN is to take what was learned from the experiences of testing and certifying solar collectors and add systems – maybe starting with compact solar water heaters.

Continue to work with standards organizations on requirements and testing of new product types (e.g., PVT) and to simplify and improve existing standards.

Assist in the implementation of certification schemes in emerging markets that do not have quality control mechanisms.

And looking a little farther down the road, explore the concept of a common Global Solar Collector Label.

More information

Global Solar Certification Network: www.gscn.solar

IEA SHC Task 57 "Solar Standards and Certification": http://task57.iea-shc.org/

Global Solar Certification Network

HOW IT WORKS FOR MANUFACTURERS

- ☐ Manufacturer is a member of GSCN.
- ☐ Manufacturer with a certification, e.g. Solar Keymark, applies directly to the new certification body (e.g., SRCC in the USA), shows his existing certificate and related test and inspection reports and other relevant documentation. Test lab and inspector used by the manufacturer are to be members of GSCN and recognized by both certification bodies.
- ☐ If no additional testing/inspection is required – or when such additional testing/inspection has been completed – the manufacturer is granted the license to mark his product with the "new" certificate too.
- ☐ Fees will apply for using the system:
  - – Fee to test lab for re-use of test reports
  - – Fee to inspection body for re-use of inspection reports
  - – Annual GSCN membership fee for manufacturers: 250 €

Manufacturers can utilize the concept of "Global Solar Certification" to avoid re-testing and re-inspection in different certification regions. Industry members can save significant amounts of money and time this way.

HOW IT WORKS FOR "OPERATORS"

(certification bodies/test labs and inspectors)

- ☐ Operator is a member of GSCN.
- ☐ Operators shall fulfill requirements given in the working rules of the GSCN. The primary requirement for operators is accreditation for the respective certification/testing/inspection.
- ☐ Participating certification bodies will recognize certification done by the other participating certification bodies if they both recognize involved test labs and inspection bodies.
- ☐ Annual GSCN membership fee for operators is 125 €

Operators participating in the Global Solar Certification Network will attract big international customers.

Members have the right to use the "Member of GSCN" logo on their company website and in other promotional material.

Become a member: **http://gscn.solar/members/Become%20member.html**

INTERVIEW

Solar Standards and Certification

Interview with Jan Erik Nielsen

The IEA SHC Programme will wrap up its work on Solar Standards and Certification (Task 57) this month. To learn first-hand of this Task's impact on standards and certification of solar thermal systems, we asked Jan Erik Nielsen, the Task Operating Agent, to share some of his thoughts on this 3-year project.

Why was this work needed?

Jan Erik Nielsen (Jan Erik): Solar collectors and solar water heaters are traded between countries and continents. But to do this is not always easy because in many cases there are national standards and certification setup with specific requirements for testing and certification, which means to sell in that country or region the manufacturers or distributors have to do testing and apply for certification many times for the same product. This is an expensive process and also requires significant time and resources. The harmonization of standards and certification requirements reduces these resources significantly.

What were the benefits of running it as an IEA SHC Task?

Jan Erik: IEA SHC provides an excellent platform for international co-operation, which is indeed needed when working on the harmonization of international standards and certification. We have ISO for elaborating and publishing the ISO standards, but normally a lot of work is needed in the preparation of standard proposals. Using IEA SHC for this (including the possibilities for funding connected to IEA SHC) makes it possible to do this preparatory work.

If someone wanted to learn more, which reports should they read first, and why?

Jan Erik: The most important ones are:

- The website WWW.GSCN.SOLAR gives information on the "Global Solar Certification Network" (GSCN) that facilitates the re-use of test and inspection reports from one certification scheme to another. The cooperation/concept makes it possible to save significant resources on testing and inspection. The specific rules/procedures/requirements are described in the "Global Solar Certification Network Working Rules" (available from this website).
- The draft proposal for four new ISO standards. These are very relevant standards for compact solar water heaters, building integrated solar components and large collector fields.
- The comprehensive guideline for the ISO 9806 collector test standard as it is very usable for both new and old test labs – and producers of solar collectors.
- The guideline for establishing certification schemes in emerging countries.

Do you have a Task success story from an end-user or industry?

Jan Erik: The first solar collector manufacturer has used the "GSCN concept" to obtain SRCC certification for their collectors in the USA based on their European Solar Keymark certification without any re-testing and re-inspection. Other manufacturers are following in this company's steps and starting the certification processes for their collectors.

Has the Task's work supported capacity and skill building?

Jan Erik: Our Task has been cooperating with the RCREEE's Solar Heating Arab Mark and Certification Initiative (SHAMCI), which is the first Arab certification scheme for solar thermal products. SHAMCI focuses on the needs of Arab states in the Middle East and North Africa and was inspired by Solar Keymark, Europe's certification scheme. This collaborative work focused on developing a guideline on how to establish certification schemes in emerging countries.

What is the future of the harmonization of standards and certification?

Jan Erik: The next step for the Global Solar Certification Network would be to include solar water heaters in the scope. This could happen in one or two years time.

Will we see more IEA SHC work in this area?

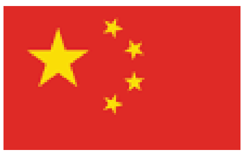
Jan Erik: The network is continuing to grow but still needs support from the IEA SHC and others to work on elaborating and improving ISO standards for existing and new solar products. That's why a proposal for a follow-up project is being worked on and will be presented at the next IEA SHC Executive Committee meeting in June 2019 so stay tune.

On the Road

SOLAR ACADEMY SHC

FOR HEATING & COOLING IN BUILDINGS & INDUSTRY

It has been a whirlwind for the SHC Solar Academy - two training courses in two continents in two months. With over 50 Tasks completed, we have an incredible pool of experts and years of expertise to share to support R&D and implementation of solar heating and cooling projects worldwide.



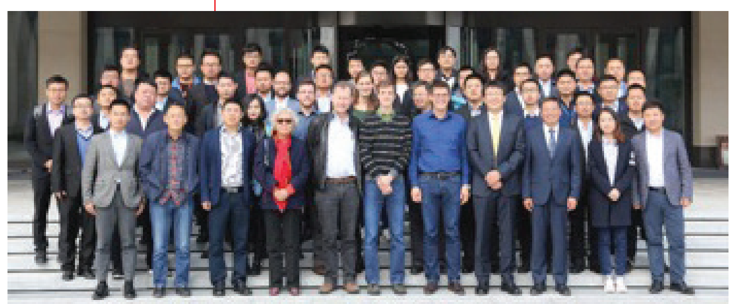
CHINA – Solar District Heating

In recent years, the Chinese solar thermal market has started to move from product retail to project development, which includes a growing trend in solar district heating projects. The SHC Programme has a long track record of work in this field so tapped into the expertise of the current Task 55 on Integrating Large SHC Systems into District Heating and Cooling Networks and the earlier Task 47 on Large Scale Solar Heating and Cooling Systems.

During the one and half days of training over 150 Chinese researchers, engineers, planners, other technical staff and students from organizations with ties to the solar thermal industry heard from the following experts:

- **Jan Erik Nielsen**, the former Operating Agent of two SHC Tasks (Tasks 45 and 57) shared his vast knowledge on system design and performance guarantee of solar district heating systems.
- **Jianhua Fan** a tenured professor of civil engineering at the Technical University of Denmark (DTU) introduced system analysis and key component selection for solar district heating systems.
- **Ruicheng Zheng**, a professor at the China Academy of Building Research (CABR) and chief engineer at the National Center for Quality Supervision and Testing of Solar Heating System (Beijing), discussed how to calculate heat consumption and design HVAC systems that comply with Chinese standards.
- **Christian Holter**, CEO of S.O.L.I.D. GmbH, an Austrian-based supplier of turnkey solar thermal systems, presented case studies on large solar heating and cooling installations.

The training was organized in cooperation with the China Academy of Building Research (CABR) and Sunrain Solar Energy, the world's largest collector manufacturer. In the words of Prof. He Tao of CABR and co-organizer of the training course, "The Solar Academy's onsite training achieved two important goals – it connected European and Chinese experts and linked the largest Solar District Heating market (Denmark) to the largest potential market (China). I hope that this is only the start to more activities between China and the SHC Solar Academy."



▲ **Solar District Heating Training at Sunrain Solar Energy's headquarters in Lianyungang with over 150 participants and four trainers.**

continued on page 11

Solar Academy *from page 10*

SOUTH AFRICA – Solar Cooling

Building on the success of South Africa's first Solar Academy training course on solar heat for industrial applications, SANEDI, in cooperation with the SOLTRAIN project and CRES from Stellenbosch University, organized another training workshop. This year's course focused on solar cooling and air conditioning. Daniel Mugnier, the Operating Agent for the recently completed SHC Task 53 on new generation solar cooling and heating systems (and SHC Chairman) and Christian Holter, the CEO of S.O.L.I.D. and expert in SHC Task 53, served as the trainers for this 3-day course.

Forty-two researchers, solar suppliers and members of public institutions from six countries (South Africa, Botswana, Namibia, Lesotho, Mozambique, and Zimbabwe) attended to learn about the application of solar cooling in the future southern African energy context. Topics presented and discussed among the participants were:

- State-of-the-art small/medium PV & ST cooling systems
- State-of-the-art large-scale solar cooling and air conditioning systems
- System concepts and preconditions (from small PV-driven systems to medium solar thermal driven systems)
- Building analysis – all components such as heat rejection and storages
- Large-scale systems – concepts and system integration with DHW
- Best practice and monitoring results – small/medium systems
- Best practice and monitoring results – large systems
- Design and dimensioning
- Financing

▲ **Solar Cooling and Air Conditioning Training at Stellenbosch University with 42 participants from 6 southern Africa countries.**

After the training, the SANEDI participant Dr. Karen Surridge remarked, "Global climate change is leading to an increased need for cooling of spaces in an environmentally friendly way. South Africa and the neighboring countries have an excellent solar resource, this means that in addition to the potential for solar cooling there is a definite need for uptake of this technology. This training sparked even more interest amongst the solar thermal community and other stakeholders in the region to begin implementing this technology."

To learn more about the Solar Academy's onsite training courses, webinar and video series visit the SHC Solar Academy webpage – at http://www.iea-shc.org/solar-academy.

Recent and Upcoming IEA SHC Academy WEBINARS

1 **Task 57: Solar Standards & Certification**
December 12, 2018

2 **Task 55: Towards the Integration of Large SHC Systems into District Heating and Cooling (DHC) Networks**
March 12, 2019

You can watch past webinars on the SHC YouTube channel click here

Advanced thermal storages - towards higher energy densities, long term storage and broader operating ranges

As the share of renewables in energy production grows so does the role for thermal energy storage. The wide range of applications for thermal energy storage presents a broad range of development conditions for advanced thermal storage technologies to supplement the existing, widely used water-based heat storage technologies. Thermal energy storage could reveal itself as a real game-changer, allowing for a notable decrease in primary energy demand, thus reducing the energy footprint. It could also support the widespread acceptance and use of renewable energy as well as the efficient use of fluctuating energy sources.

A few specific thermal storage concepts are already part of our daily life. For example, in many district heating networks water storages are being used to decouple the electricity and heat generation in cogeneration plants. Another example is concentrating solar power plants that are creating dispatchable solar electricity by using state-of-the-art two-tank molten salt storages technology.

Why do we need advanced thermal storages?

Although several success stories like the ones mentioned above can be told, the current portfolio of storage technologies cannot serve all possible thermal energy storage (TES) applications. For example, industrial applications call for high temperatures, particularly when dealing with steam, in a very narrow temperature range. And, cooling and heating applications can be hampered by space restrictions and therefore demand higher energy densities of the storage. An overview of such applications and their main driver for development is given in the table below.

In particular, phase change materials (PCM) and thermochemical materials (TCM) comply with higher energy storage densities and offer the perspective of nearly loss-free long term storage. The advantages of higher material energy density and loss-free storage are well known, but the implementation of actual storage systems continue to be challenging. SHC Task 58 /ECES Annex 33: Material and Component Development for Thermal Energy Storage is addressing the challenge and has made significant progress in standardized measurement protocols, materials and component development and system concepts for specific use-cases.

Industrial waste heat utilization, process optimization & solar process heating

Apart from preheating cases, integration of solar heating in industrial processes calls for storages operating at temperatures above 150°C to deliver the required process heat or steam. At these temperatures, water storage reaches its limit and, with increasing temperature, direct steam storage also becomes challenging due to the high-pressure levels and related high costs. When process steam is required, the heat should be delivered in a very narrow temperature range, calling for PCMs and TCMs, which offer the advantage of high storage capacity at nearly constant temperature level.

Similar requirements apply for the recuperation of waste heat either as heat or electricity in combination with a power cycle, as well as the integration of storages to improve process efficiency.

continued on page 13

Temperature level	Application	Driver
Charge T unrestricted	**Power-to-Heat / Process steam**	**Energy density**
10°C	Solar Cooling	High energy density, low temperature
60- 110 °C	Climatization in Cars	High energy density
60 - 120°C	Solar Heating	High energy density Seasonal storage
> 150°C	Solar Process Heat / Steam	Higher temperatures
> 200°C	High T Waste heat recuperation	Higher temperatures
250-400°C	Industrial CHP	Higher temperatures
> 600°C	Concentrated solar power	Higher temperatures, higher storage densities

In this context, thermochemical storage systems based on reversible chemical reactions using, for example, SrBr2, MgO or CaO enable both the upgrading and transporting of the recovered heat. When combined with power-to-heat, the storages provide an alternative to simultaneously generate process steam and store renewable electricity for later use as heat and/or electricity.[1]

Solar heating and cooling

In this sector, water and ice storage in district heating networks have seen increased usage and been used successfully to improve efficiency and reduce the size of the generation plant. However, about 80% of dwellings in Europe are not connected to district heating, so decentralized solutions on both the community and building level are required. These applications face very stringent space restrictions and hence require storages with a substantially increased energy density compared to current sensible storage systems. In this application range, TES based on sorption materials like zeolites[2], aluminum phosphates or salt-hydrates are just a few exciting examples of applications, where energy density and compactness are fundamental properties.

With increasing penetration of renewables, longer term storage becomes increasingly important to bridge the time and location gap between heat/cold generation and use.

Mobile and transportable heating

In the field of mobility, thermal energy storage will play an important role. In electric cars, for example, thermal storages will be a key element to ensure energy efficient climate inside vehicles. Storages are in this case subjected to very stringent space and weight restrictions.

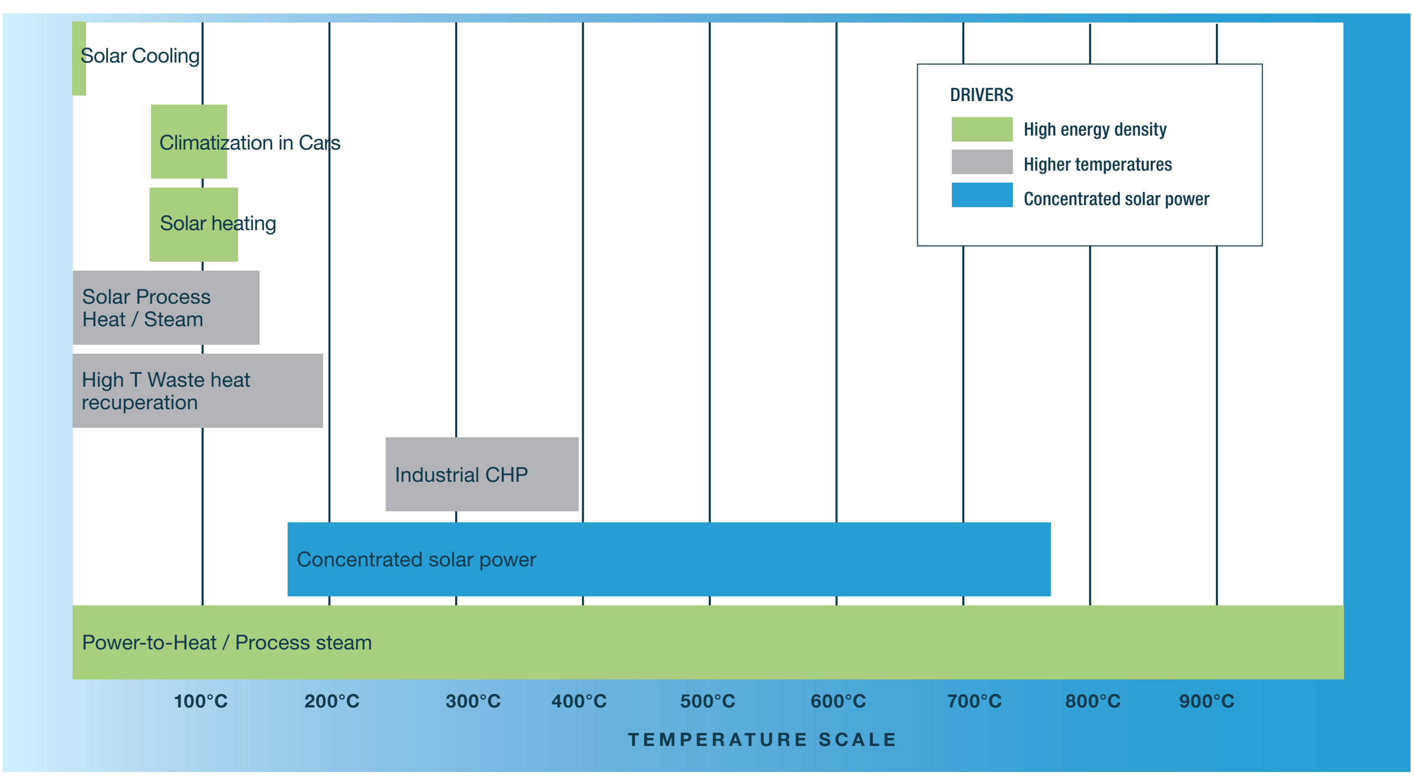
For waste heat recovery an energy dense and efficient storage is required to allow for the cost-effective transportation of waste heat to the consumer site. As projects in Germany have shown, the costs for transporting waste heat are currently dominated by labor costs. However, in a future with autonomous driving cars this will no longer be the case; thus high energy density heat transport might become an interesting option supporting the decarbonization of the industry.

Flexibility in the power grid

As previously discussed, cogeneration combined with energy storages allows for more flexible electricity generation while ensuring that the heat demand is met. In district heating, stratified water storages are state-of-the-art. In industrial cogeneration, high temperature storages are required. Depending on the power and capacity requirements for this application both PCM (high power[3]) or TCM (longer storage periods) using e.g. CaO or MgO[4,5], being developed.

When grid flexibility is needed, power-to-heat and power-to-cold are gaining interest. On a national level, both options provide an efficient way to integrate renewable peak electricity generation, thereby providing flexibility in the electricity grid and simultaneously substituting gas in the heating sector. Even on the local level, power-to-heat offers a compact alternative for solar thermal systems to

continued on page 14



Horizon 2020

Horizon 2020, the multi-annual Programme for Research and Innovation of the European Union (EU), has launched two new funding opportunities for thermal storage projects in line with MI Innovation Challenge 7: Affordable Heating and Cooling of Buildings.

Horizon 2020
European Union Funding
for Research & Innovation

The two funding opportunities, promoting collaborative research and innovation activities, specifically reference the involvement of non-EU Mission Innovation members. They address:

1. The development of compact thermal energy storage for electricity load shifting (Topic LC-SC3-ES-6-2019 – Opening date: 5 September 2018 – Deadline: 0 February 2019)
2. The demonstration of high density, integrated thermal storage based on thermochemical materials (Topic LC-EEB-05-2019-20 – Opening date: 16 October 2018 – Deadline: 21 February 2019)

The challenge set by LC-SC3-ES-6-2019 is to develop compact thermal energy storage for electricity load shifting that will take up electricity from the grid at peak times, to be used for heating, cooling or hot tap water at other times. Integration into the building heating system and in the smart electricity grid is a key development element together with the storage materials and technologies.

LC-EEB-05-2019-20 seeks projects to develop new integrated thermal storage systems and overcome the limits of the current mature technologies for thermal storage, mostly based on water. Developing new systems based on thermochemical materials can significantly increase storage density.

Innovative storage solutions can improve the efficiency of the overall supply and demand system at residential, district and urban level, manage peak loads and reduce the operational costs of installations.

Advise on preparing Horizon 2020 project proposal is available at: H2020 online manual, FAQ, IT assistance, National Contact Points.

Task 58 *from page 13*

provide space heating, as well as process steam. The technological options in this regard range from simple heating rods and electro-boilers to heat pumps or compression chillers, driven by wind or solar energy.

Conclusion

Thermal storages are an essential component of a highly efficient and renewable energy future. They allow for the cost-effective integration of renewable energy not only in the heating and cooling sector but also in the electricity sector. However, the application cases discussed above show that no single storage solution can serve all applications. To unlock their full potential, further developments are required to develop storages meeting the specific requirements of a particular application. The main drivers in this development are the need for application temperatures beyond the working range of water, higher energy densities, energy charging and discharging in narrow temperature ranges, and low energy losses enabling long term heat storage while guaranteeing a cost-effective application. In particular, advanced systems based on PCM and TCM provide very promising solutions and require an international, long term research and development initiative.

This article was contribute by Annelies Vandersickel - Lehrstuhl für Energiesysteme, Technische Universität München, Germany; Danny Müller – Institute of Applied Synthetic Chemistry, TU Wien, Vienna, Austria; Wim van Helden – AEE INTEC, Gleisdorf, Austria; Saman

[1] Michael Angerer, Gesa Backofen, Dr. Annelies Vandersickel and Prof. Hartmut Spliethoff, Power-to-heat with high temperature thermochemical energy storage – A solution for renewable and affordable industrial process heat, IRES 2019

[2] Köll R., van Helden W., Engel G., Wagner W., Dang B., Jänchen J., Kerskes H., Badenhop T., Herzog T., "An experimental investigation of a realistic-scale seasonal solar adsorption storage system for buildings," Solar Energy Vol.155, pp. 388-397, 2017

[3] Maike Johnson,Andreas Dengel,Bernd Hachmann,Dan Bauer, INTEGRATION OF A LATENT HEAT STORAGE UNIT IN A COGENERATION PLANT, October 2018, International Sustainable Energy Conference 2018, Graz, Austria

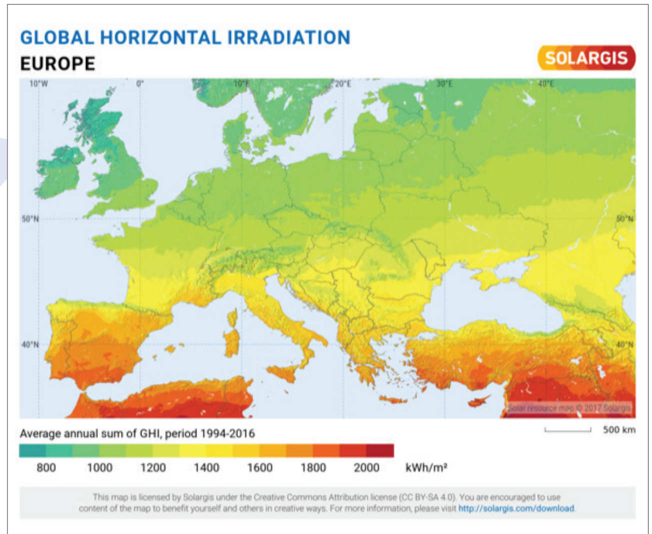
[4] Angerer, M.; Djukow, M.; Riedl, K.; Gleis, S.; Spliethoff, H.: Simulation of Cogeneration-Combined Cycle Plant Flexibilization by Thermochemical Energy Storage. Journal of Energy Resources Technology 140 (2), 2018

[5] Angerer, M.; Becker, M.; Härzschel, S.; Kröper, K.; Gleis, S.; Vandersickel, A.; Spliethoff, H.: Design of a MW-scale thermo-chemical energy storage reactor. Energy Reports 4, 2018

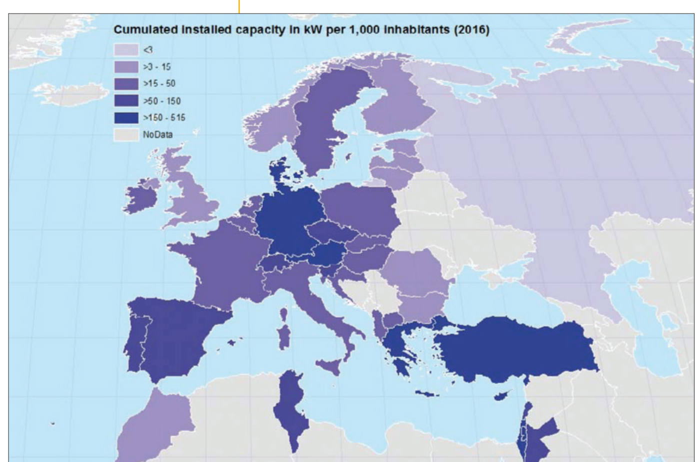
COUNTRY HIGHLIGHT

Portugal: Sun & Innovation Drive Change

Portugal has one of the highest solar energy resources in Europe (see Figure 1), but the solar thermal market in Portugal is not in line with this fact as can be seen in the most recent publication of the IEA SHC's Solar Heat Worldwide (see Figure 2). Portugal's cumulated installed capacity is lower than in other European countries with much lower solar resources.



▲ **Figure 1. Global Horizontal Irradiation**
(Solar resource map © 2018 Solargis)



▲ **Figure 2. Solar Thermal market penetration per capita in Europe in kWth per 1000 inhabitants**

Solar Resource versus Market Penetration

Portugal's abundant solar resource has served as the basis for incentives to increase the application of solar thermal technologies starting in the 1970s. Along the years, the public policies gave mainly fiscal incentives for the installation of solar thermal systems for domestic hot water preparation. Despite these incentives, the installed collector area in 2000 was only 219,500 m².

In the 2000s, public policies were implemented to profit from this resource but added the "quality" paradigm. In 2001 a program called "Solar Hot Water for Portugal" was implemented, and it introduced certification schemes for:

1. Solar thermal collectors and systems, which was very similar to Solar Keymark also implemented at the same time at the European level, and
2. Installers of solar collectors and systems.

In 2002, the Directive 2002/91/EC of the European Parliament and the Council on the energy performance of buildings was published, and the work of transposition to the Portuguese law initiated. Benefiting from the work performed in the framework of the "Solar Hot Water for Portugal" program, the transposition of the Directive introduced the obligation to use solar thermal collectors for hot water preparation in new buildings and large renovations. This obligation included the following criteria: only solar thermal systems with certified collectors, installed by certified installers and having six years guarantee could be accepted for verification of this obligation.[1]

These policies were important for growing the solar thermal market and supported by some fiscal incentives. Fiscal incentives were directed towards families as individual income tax deductions as well as towards corporate income taxes (for a few years a very beneficial condition was possible – the amortization of investment in renewable energies could be done in four years).

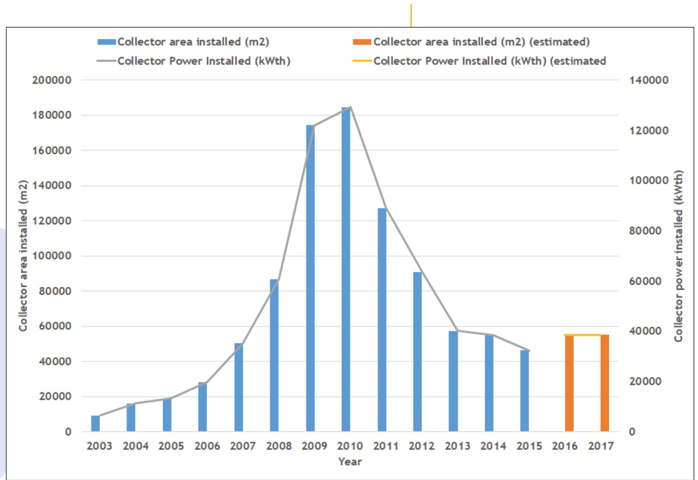
In 2009 an effective solar thermal incentive program busted the growth of the market especially in the domestic sector (a solar thermal system for a single-family home could be purchased for a reduced price of 30% to 60% depending on the type and size of the system). Deductions in individual income taxes could also be applied. In 2010 the

continued on page 16

incentive scheme was directed to the social service sector, but the financial crises lead to the end of this incentive in a few years along with the fiscal incentives.

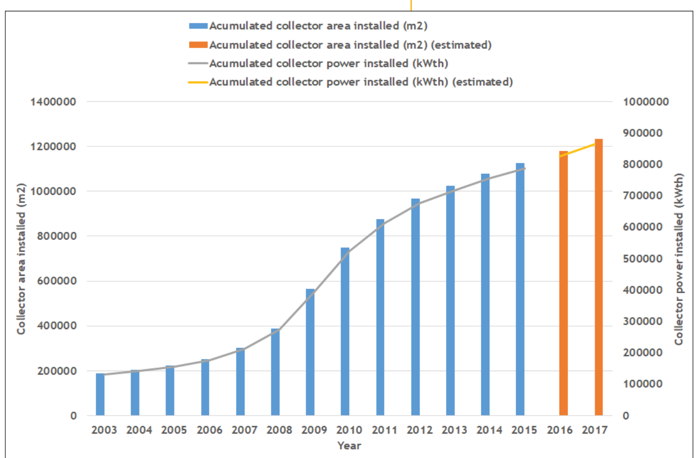
Presently, although statistics are not available past 2016, the total installed collector area is around 1.2 million m^2, primarily in the residential sector. Figures 3a and 3b show the latest market statistics dated from 2015.

The National Action Plan for Renewable Energies (PNAER) forecasts an 11.5% annual average installation rate for solar thermal collectors with a total capacity of 2.2 million m2 by the year 2020. However, contrary to the objectives of the PNAER, an annual average decrease of 30% between 2010 and 2012 was recorded followed by a 37% decrease in 2013. Between 2013 to 2015, the average decline was around 10%. There is no information available for 2016 and 2017, but we can expect an increase since the construction market is now growing with the construction of new buildings and the retrofitting of old buildings and the fact that building regulations continue to require the installation of solar thermal collectors for water heating. However, to recover from the low installation rates observed between 2010 and 2015, there is still a need for an extra effort to meet the 2020 objectives of the PNAER.



▲ **Figure 3a. Collector area/power installed per year[2]**

Work on a new National Plan for the period 2021-2030 (Integrated National Plan for Energy and Climate) is already underway, and the first proposal is expected at the end of 2018. In this plan, new and increased objectives for renewable energies and heating and cooling are expected.



▲ **Figure 3b. Cumulated collector area/power installed per year[2]**

Solar Thermal in Portugal

Most of the collector capacity installed in Portugal is in the domestic sector for hot water preparation. A small fraction is for large installations in hotels, swimming pools, elderly homes, and schools (the average area of these installations is 40 m^2). The share of large installations was around 10% in 2015. This may be explained by the fact that Portuguese legislation only mandates the installation of solar thermal collectors for the preparation of hot water in individual homes and does not extend this obligation to the service sector.

That said, there are examples of service sector installations worth noting.

One emblematic installation is the heating and cooling installation at the Headquarters of CGD Bank (see Figure 4). This installation is the largest installed on a service building with 1,600 m^2 of collectors mounted on the rooftop, which save up to 70% of the energy required for the building's water heating and have a cooling capacity of 545 kW using an absorption chiller. The system was commissioned in 2008.

Another installation of note is at the Calouste Gulbenkian Foundation Headquarters. This building is considered a national monument and so special care was taken to ensure that the installation would have no visual impact on the building. In this case, vacuum tubes were installed almost at a horizontal position (see Figure 5). The solar thermal system was installed to produce hot water and thereby reduce the consumption of fossil energy in the Headquarter's Building and Modern Art Center. The system has a rated power of approximately 67kWth, which corresponds to a gross collector area of slightly less than 140m^2 and is expected to provide 77MWh of power per year. The average daily consumption of hot water is 7m^3 at 60°C and so covers approximately 60% of the FCG's hot water needs.

continued on page 17

In Portugal, there are only a few solar process heat installations despite their tremendous potential. One example is an installation with parabolic trough collectors (ICARUS HEAT) at Silampos, a manufacturer of mostly stainless steel kitchenware. The industrial process requires washing and drying finished products at a temperature range of 50°C and 160°C. Another industrial application that can be reported is the use of solar thermal systems for the production of hot water used for natural gas preheating at Gas Regulation and Measuring Stations. Two such installations were built in 2012 by REN – the national energy network operator.

▲ **Figure 4. Solar thermal installation at the CGD's Headquarters in Lisbon, Portugal**

Portuguese Manufacturers

Although much higher numbers were reported during the peak of the solar thermal industry in 2009-2010, it is estimated now that there are around five manufacturers of collectors and storage tanks. The majority of the commercial systems (produced and imported) are based on flat plate collectors (98.2% according to Solar Heat Europe's report, "Solar Thermal Markets in Europe - Trends and Market Statistics 2015). Figure 6 shows a large solar thermal installation with flat plate collectors produced by the Portuguese company OpenPlus.

Storage tanks are also produced in Portugal by the Portuguese company, VIDEIRA, LDA and by the international company, Worthington Industries. These companies are also exporters.

Portuguese Innovation

Examples of the innovative products being developed in Portugal include SUNAITEC's tracking collector. This one axis tracking collector can be installed horizontally and be used as a shading device, or can be mounted vertically on a facade (see Figures 7 and 8).

Another innovative concept was developed by the T&T, a Portuguese company working in home automation, energy efficiency and sustainability. The company's air and water heating collector for façade integration is unique. Installed on a façade of their Headquarters these collectors circulate the hot water in tubes connected to the absorber while the air circulates in the space between the glass and absorber and the warm air can then be injected into the building when space heating is needed (see Figure 9).

▲ **Figure 5. Collectors at Calouste Gulbenkian Foundation in Lisbon, Portugal** (photo credit: FCG)

Another Portuguese company, MCG, within the framework of the European project REELCoop, developed a stationary evacuated CPC solar collector to provide a high operating temperature (outlet temperature of 177°C) with high efficiency (51%) at a maximum solar radiation level (1000 W/m^2). The

▲ **Figure 6. A solar thermal installation with flat plate collectors produced by the Portuguese company OpenPlus for domestic hot water preparation (580 m2) in Matosinhos, Portugal** (photo credit: Openplus)

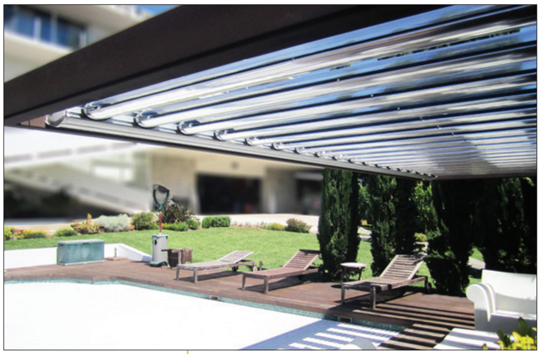
◂ **Figure 7. Collectors used for hot water preparation and swimming pool heating at the Bela Vista Hotel and Spa in Paria da Rocha**

continued on page 18

Portugal *from page 17*

evacuated CPC solar collectors combined with a biomass boiler burning olive oil waste is used to drive an ORC power cycle with a micro-expander and with the possibility of using useful heat from the ORC cycle condenser and boiler recovery. This prototype is installed in Ben Guerir, Morocco (see Figure 10).

As part of the national SHIP (Solar Heat for Industrial Processes) project, MCG in cooperation with two other companies, KEMET and ONControl, and with University of Évora and INEGI (research partners) is further developing the collector for installation at Kemet Electronics Portugal, S.A. in Évora, Portugal.



▲ **Figure 8. Collector used for swimming pool heating in Estoril**

Research Activities

Currently, there is no specific national R&D program for solar thermal or solar buildings in Portugal. However, universities, research institutes, and businesses can apply for national programs, where it has been possible to accommodate part of the research and demonstration needs of solar technologies. These programs are managed by:

- FCT (Science and Technology Foundation) that supports graduate education and training, carrier development, research and development grants, research units, etc., in all areas of science and technology.
- Portugal 2020 that sponsors R&D in industry and services, promoted by businesses that can apply alone, in a consortium or as subcontract R&D national entities.
- In the framework of the Portuguese Roadmap on research infrastructures (2014-2020), the area of "Energy" has four research infrastructures, of which two have a strong connection to research in the field of solar energy:
- NZEBLab Research Infrastructure on Integration of Solar Energy Systems in Buildings that is coordinated by LNEG.
- INIESC (National Research Infrastructure Solar Energy Concentration) that is coordinated by the University of Évora with the participation of LNEG.

▲ **Figure 9. Collectors used for hot water preparation and air heating at the T&T Headquarters (Project Senergy Force) in Vouzela, Viseu, Portugal**

This article was contributed by Maria João Carvalho and João Farinha Mendes of LNEG and the Portuguese SHC Executive Committee members.

▲ **Figure 10. MCG's CPC collectors with evacuated tube receiver.**

---

[1] Directive 2002/91/EC of the European Parliament and the Council, 16 December 2002 on the energy performance of buildings, withdrawn and replaced by Directive 2010/31/EU of the European Parliament and the Council, 19 May 2010 on the energy performance of buildings

[2] ref. 4: ADENE/ DGE/ INETI (2001) "Água Quente Solar para Portugal" ISBN 972-8646-02-X https://www.aguaquentesolar.com/publicacoes/15/Brochura_AQS.pdf

SHC Publications

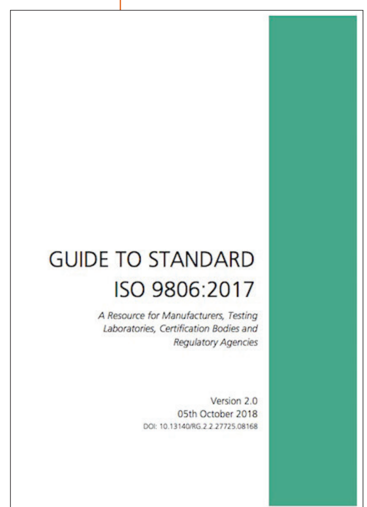
New Publications Online!

New reports and articles are regularly posted on our website, so please check often. Below are a few recent reports not to miss. You can read them online or download them for free. Our complete library of publications – online tools, databases, journal articles and more – dating back to the start of the SHC Programme, can be found on our website under the tab "Publications and Databases" or under a specific Task.

SOLAR STANDARDS AND CERTIFICATION

Guide to Standard ISO 9806:2017

This is a valuable resource on the application and use of ISO 9806 for testing solar thermal collectors prepared specifically with three different target groups in mind – manufacturers, testing laboratories, certification bodies, and regulatory agencies. For collector manufacturers and importers, the goal is to give a very light introduction to the standard and to explain how it is used for type testing as well as for innovation and development support. For laboratories, the goal is to give a quick introduction to the standard for new laboratories and in general to contribute to a uniform interpretation of the standard and presentation of results. For certification bodies and regulatory agencies, the intention is to provide access to a straightforward evaluation of the presented results.



SOLAR ENERGY IN URBAN PLANNING

Approaches, Methods and Tools for Solar Energy in Urban Planning

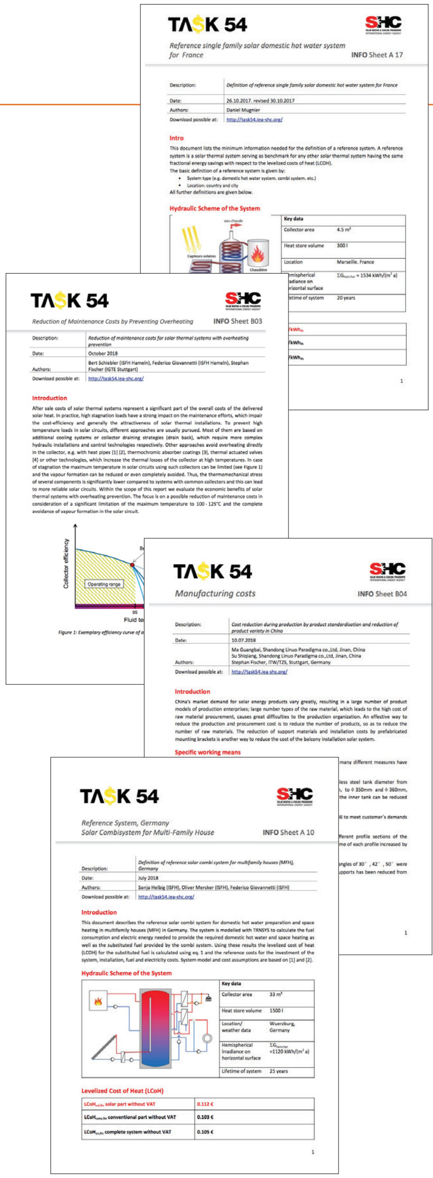
Approaches, methods and tools presented in this report are to be used to support and facilitate the consideration of daylight and solar energy in urban planning processes. Future cities and landscapes will not only use energy but will also locally generate renewable energy, often through solar energy. Therefore, this report presents different ways to address existing building stock, new urban environments and landscape environments in relation to the use of daylight and active solar while respecting cultural and historical heritage values.

PRICE REDUCTION OF SOLAR THERMAL SYSTEMS

LCoH Online Tool

An easy to use Excel-based tool to calculate the Levelized Cost of Heat of solar thermal systems. Use this tool to compare the effects of different technological solutions and designs on reducing the LCoH or to compare solar thermal systems with other heating systems over their service lifetime.

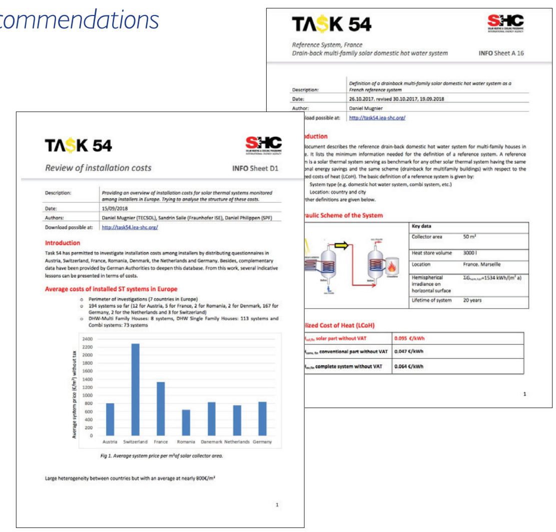
continued on page 20



PRICE REDUCTION OF SOLAR THERMAL SYSTEMS

New additions to the Info Sheet series!

- *Reference single-family solar domestic hot water system for France*
- *Reference System, France Drain-back multi-family solar domestic hot water system*
- *Reference multi-family solar domestic hot water system. France*
- *Reference System, Germany Solar Combisystem for Multi-Family House*
- *Manufacturing costs*
- *Reduction of Maintenance Costs by Preventing Overheating*
- *Obstacles in Installation and Recommendations*
- *Review of installation costs*
- *Heat Changers*



Interview *from page 5*

What is the future of the technology – new developments, market and policies needed?

Daniel: The main evolution in the sector will be the critical need for emerging and sunny/hot countries to adopt technical solutions for cooling (air conditioning and refrigeration). Therefore, an important driver for future developments will be the work of adaptation of several parts of the solar cooling systems: heat rejection, control, solar collection as well as exploitation and maintenance. A very strategic technology transfer from traditionally experienced countries (mainly OECD ones) to emerging sunny countries is needed because the main markets are not where the know-how is at the moment. A re-orientation of the market and the subsequent innovations will profit as well to traditional countries because of the general global warming trend.

Will we see more work in this area in IEA SHC?

Daniel: Certainly, we are working hard on developing a new SHC Task called "Solar Cooling in the Sunbelt Regions" which means focusing on creating innovative and adapted systems for intertropical countries with sunny and hot conditions. The focus would be on the range of 10 to several hundreds of kWcooling so as to be differentiated from other ongoing work and tasks[2] on small green air conditioners. We hope to foster collaboration between IEA SHC members and Mission Innovations Challenge 7[3] market players on this challenging work and kick-off the work in 2019.

---

[1] https://www.iea.org/cooling/

[2] https://globalcoolingprize.org/

[3] http://mission-innovation.net/our-work/innovation-challenges/heating-cooling-challenge/

IEA programme SHC

The International Energy Agency was formed in 1974 within the framework of the Organization for Economic Cooperation and Development (OECD) to implement a program of international energy cooperation among its member countries, including collaborative research, development and demonstration projects in new energy technologies. The members of the IEA Solar Heating and Cooling Agreement have initiated a total of 62 R&D projects (known as Tasks) to advance solar technologies for buildings and industry. The overall Programme is managed by an Executive Committee while the individual Tasks are led by Operating Agents.

Follow IEA SHC on

SOLARUPDATE

The Newsletter of the IEA Solar Heating and Cooling Programme

Vol. 68, December 2018

Prepared for the IEA Solar Heating and Cooling Executive Committee

by

KMGroup, USA

Editor:
Pamela Murphy

www.iea-shc.org

Current Tasks and Operating Agents

Price Reduction of Solar Thermal Systems
Dr. Michael Köhl
Fraunhofer Institute for Solar Energy Sytems
Heidenhofstr. 2
D-79 110 Freiburg
GERMANY
michael.koehl@ise.fraunhofer.de

Towards the Integration of Large SHC Systems into District Heating and Cooling (DHC) Network
Ms. Sabine Putz
S.O.L.I.D.
Puchstrasse 85
8020 Graz
AUSTRIA
s.putz@solid.at

Building Integrated Solar Envelope Systems for HVAC and Lighting
Dr. Roberto Fedrizzi
EURAC Research
Institute for Renewable Energy
Via A. Volta 13/A
I-39100 Bolzano
ITALY
roberto.fedrizzi@eurac.edu

Solar Standards and Certification
Mr. Jan Erik Nielsen
SolarKey International
Aggerupvej 1
DK-4330 Hvalsö
DENMARK
jen@solarkey.dk

Material and Component Development for Thermal Energy Storage
Dr. Wim van Helden
AEE INTEC
Feldgasse 19
A-8200 Gleisdorf
AUSTRIA
w.vanhelden@aee.at

Renovating Historic Buildings Towards Zero Energy
Dr. Alexandra Troi
EURAC Research
Institute for Renewable Energy
Via A. Volta 13/A
I-39100 Bolzano
ITALY
alexandra.troi@eurac.edu

PVT Systems
Mr. Jean-Christophe Hadorn
Solar Energy & Strategies
11 route du Crochet
CH 1035 Bournens
SWITZERLAND
jchadorn@gmail.com

Integrated Solutions for Daylighting and Electric Lighting
Dr. Jan de Boer
Fraunhofer Institute of Building Physics
Nobelstr. 12
70569 Stuttgart
GERMANY
jan.deboer@ibp.fraunhofer.de

Solar Energy in Industrial Water and Wastewater Management
Mr. Christoph Brunner
AEE INTEC
Feldgasse 19
A-8200 Gleisdorf
AUSTRIA
c.brunner@aee.at

IEA Solar Heating & Cooling Programme Members

AUSTRALIA	Mr. K. Guthie	ITALY	Mr. G. Puglisi
AUSTRIA	Mr. W. Weiss	MEXICO	
BELGIUM	Prof. S. Altomonte	NETHERLANDS	Mr. D. van Rijn
CANADA	Mr. B. Wong	NORWAY	Dr. M. Meir
CHINA	Prof. H. Tao	PORTUGAL	Dr. M.J. Carvalho
DENMARK	Mr. F. Madsen	RCREEE	Mr. A. Kraidy
ECI	Mr. N. Cotton	SLOVAKIA	Mr. A. Bobovnický
ECREEE	Mr. G. Kouhie	SOUTH AFRICA	Dr. T. Mali
EUROPEAN COMMISSION	Mrs. S. Bozsoki	SPAIN	Dr. M.J. Jiménez
FRANCE	Mr. P. Kaaijk	SWEDEN	Ms. A. Pettersson
Germany	Ms. K. Krüger	SWITZERLAND	Mr. A. Eckmanns
ISES	Ms. J. McIntosh	TURKEY	Dr. B. Yesilata
		UNITED KINGDOM	Mr. K. Sample

CHAIRMAN
Dr. Daniel Mugnier
TECSOL SA.
105 av Alfred Kastler - BP 90434
66 004 Perpignan Cedex, FRANCE
Tel: +33/4 68 68 16 42
chair@iea-shc.org

SHC SECRETARIAT
Ms. Pamela Murphy
KMGroup
9131 S. Lake Shore Dr.
Cedar, MI 49621
USA
Tel: +1/231/620 0634
secretariat@iea-shc.org