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Newsletter of the International Energy Agency Solar Heating and Cooling Programme

SHC Solar Award Saluts Canadian Company

The recipient of the 2013 SHC Solar Award is the Drake Landing Company of Alberta, Canada – a perfect example of successful collaboration. The company, comprised of four organizations, United Communities (developer), Sterling Homes (builder), ATCO Gas (utility), and the Town of Okotoks (municipality), was formed to oversee ownership and operation of the Drake Landing Solar Community. The community uses solar thermal collectors and borehole heat storage to provide space heating to 52 homes, and recently set a new world record of 98% solar heating performance.

▲ **Canada's Drake Landing Company receives SHC Solar Award. Recipients Bruce Littke from ATCO Gas (2nd from left) and Keith Paget from Sterling Homes (3rd from left) are joined by Doug McClenahan, Canadian SHC Executive Committee member (1st from left) and Werner Weiss, SHC Programme Chair (4th from left).**

Bruce Littke from ATCO Gas and Keith Paget from Sterling Homes received the award on behalf of the Drake Landing Company at *SHC 2013: International Conference on Solar Heating and Cooling for Buildings and Industry* in Freiburg, Germany.

The SHC Solar Award is given to an individual, company, or private/public institution that has shown outstanding leadership or achievements in the field of

continued on page 3

Exhibition Showcases Innovative Polymeric Collectors and Components

A highlight of the SHC 2013 conference was the showcase of innovative polymeric collectors and components. With the aim to highlight novel designs and research trends for cost-efficient solar thermal systems, *SHC Task 39: Polymeric Materials for Solar Thermal Applications* selected promising polymeric collectors and storage tanks and placed them on an exhibition truck in front of the conference venue. The unique assembly of the most up-and-coming polymer based products demonstrated the first tangible results of SHC Task 39's research and underlined the high potential of plastics for the future solar thermal energy sector.

"On the road to a new generation of solar thermal energy" was the motto of the exhibition that hosted some of the most innovative solar thermal products of polymeric materials. Next to scalable collectors for building integration by the Norwegian

continued on page 2

In This Issue

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SHC 2013 Exhibit *from page 1*

company Aventa AS, SHC Task 39 showcased polymeric collectors of the Israeli company Magen Ecoenergy, the solar air collector LUBI by the Canadian Enerconcept Technologies as well as storage tanks by the German manufacturers Roth and Consolar, and novel components and material combinations by the Austrian research institute Wood K-Plus. Current research activities were presented by the SHC Task 39 partners of ITW Stuttgart (Germany), PCCL, the University of Leoben and Sunlumo (Austria), who took the opportunity to present their projects and offered guided tours through the exhibition truck.

▲ **Figure 1. SHC Task 39 outdoor exhibit at SHC 2013 in Freiburg, Germany.** (Photo: Fraunhofer ISE)

Novel design and cost-efficiency

The exhibits distinguish themselves from standard collectors and components in their material choice and also decisively in their design. The Aventa solar collector, for example, is specifically fashioned as an architecturally appealing building element (see Figure 2). Based on extruded PPS and PC it can be easily adjusted to any wall or facade structure. Variations in color allow for visual integration and make Aventa collectors frontrunners in terms of practicability and aesthetical quality. Magen's eco-SPARK® and eco-FLARE® collectors, in turn, consist of specially formulated polymeric compounds suited for the effective operation in sunny and Mediterranean countries. Both collectors can be applied in thermosiphon systems and are widely installed in large commercial applications (eco-FLARE®, Figure 3, left) or in systems for swimming pool heating and domestic hot water preparation (eco-SPARK®, Figure 3, right). All polymeric solar collectors such as these are perfectly compatible with a range of new polymeric storage tanks. Solutions for space saving, lightweight storages were shown by the German manufacturers Roth and Consolar.

> The Task 39 Exhibition has had a great impact on the visitor's acceptance of polymeric materials in solar systems. The exhibit demonstrated that there already exist some quite interesting and above all reliable and efficient products.
>
> MICHAEL KÖHL
> Operating Agent of SHC Task 39

A special highlight of the exhibition was the prototype of a fully polymeric thermisophon (patent pending) conceptualized in the frame of the European project SCOOP. Therm-X is the result of a study on low-cost collectors for sunny regions and built by a team from Fraunhofer ISE. This design is based on extruded Polypropylene twin wall sheets that offer the possibility of mass production. The exhibited prototype has a collector area of 1.2m^2 and a storage capacity of 65 liters.

▲ **Figure 2. Scalable Aventa solar collectors for facade and building integration.** (Photo: Fraunhofer ISE)

A world of possibilities

The SHC Task 39 Exhibition opened up a world of possibilities for rethinking solar thermal. The showcase perfectly demonstrated that polymers in solar thermal are not just wishful thinking, but a factor to be reckoned with. When it comes to aspects like cost-reduction, mass production and easy installation, plastics are a possible way to pursue, and may in fact be the key to push, the market penetration of solar thermal installations yet again. With this objective, the Exhibition perfectly

continued on page 3

SHC Solar Award *from page 1*

"The Drake Landing Solar Community is a clear number one in many respects," said Werner Weiss, chairman of the IEA SHC Programme. "It is the first large-scale solar district heating system with seasonal storage in North America. And, it is the first in the world designed to provide over 90% of the space heating load from solar energy. Having achieved its goal, it has become a stellar example for solar heating and cooling worldwide."

WERNER WEISS
IEA SHC Chairman

solar heating and cooling, and that supports the work of the IEA Solar Heating and Cooling Programme.

The Drake Landing Company is the 8th recipient of the SHC Solar Award and the first company to receive this honor in recognition not only of the project's excellent results, but also the pioneering spirit of the involved partners. With no previous experience in designing, building and operating a large-scale solar community system, these organizations underwent a steep learning curve, which began with a study tour of the major solar seasonal storage projects in Europe and culminated with a final design workshop to review and finalize the major design concepts for the Canadian project. Their enthusiasm, dedication and support throughout the design, construction, and performance monitoring periods enabled the Drake Landing project to achieve the success it has today, exceeding expectations and setting a new world record, 98% solar heating fraction in its sixth year of operation.

The heat for the homes in the Drake Landing Solar Community is generated from an array of 800 solar thermal collectors mounted on the garage roofs. The collectors generate a combined 1.5 megawatts of thermal power on a typical summer day. The heat is collected in a short- term storage and from there pumped into a borehole energy storage system comprised of 144 holes stretching to a depth of 37 metres and covering an area of 35 metres in diameter. By the end of summer, the earth of the seasonal storage reaches over 70°C. In winter, water is pumped through the pipes in the boreholes to collect the heat to be delivered to the homes.

The Drake Landing Company joins the list of other SHC Solar Award recipients – Fred Morse, Helmut Jäger, Manuel Collares Pereira, Volker Wittwer, Jan-Olof Dalenbäck, William Beckman, and Torben Esbensen. The SHC Programme is recognizing leaders in the field of solar energy not only for their contributions, but also to demonstrate that solar energy is a viable energy source for heating and cooling.

For more information on the Drake Landing Solar Community visit www.dlsc.ca.

▲ **Figure 3. Polymeric solar collectors from the Israeli company Magen Ecoengery. Magen eco-FLARE®, (left), Magen eco-SPARK® (right).**

◀ **Figure 4. Extruded thermosiphon system Therm-X. Design: EU SCOOP, built by: Fraunhofer ISE.** (Photo: Fraunhofer ISE)

SHC 2013 Exhibit *from page 2*

echoed the call of this year's SHC 2013 conference, which encouraged the visitors to find new ways to revive the potential of this important technology. Michael Köhl, Operating Agent of SHC Task 39 and one of the initiators of the exhibition agrees that the exhibition accomplished one of its goals, *"The Task 39 Exhibition has had a great impact on the visitor's acceptance of polymeric materials in solar systems. The exhibit demonstrated that there already exist some quite interesting and above all reliable and efficient products."*

This article was contributed by Sandrin Saile, Andreas Piekarczyk, Michael Köhl of Fraunhofer ISE, Germany. For more information visit the SHC Task 39 webpage.

Hundreds of Solar Thermal Experts Converged on the City of Freiburg

SHC 2013 Conference

SHC 2013, the 2nd International Conference on Solar Heating and Cooling for Buildings and Industry, was held in Freiburg, Germany this past September. For three days, 400 experts from 36 countries discussed technological developments, markets and political framework conditions. The 15 keynotes, 90 oral presentations, and 140 posters provided a diverse forum for participants to learn about and share the state-of-the-art in solar thermal.

This time, as the conference moved from North America to Europe, the SHC Programme teamed up with the European Solar Thermal Industry Federation (ESTIF). Together they hosted the conference, bringing together researchers, industry and other important stakeholders in our sector. And while the majority of sessions focused on technological topics, several sessions specifically addressed industry topics, such as market developments in different countries and regions, analysis of existing public support mechanisms, and policies aimed at increasing the share of net zero energy buildings.

IEA SHC chairman, Werner Weiss, presented an overall positive view on the state of the worldwide solar thermal market highlighting the growth of 14% in 2012.*"On a world-wide scale, we are on track to our goal of providing half of the low-temperature heat demand with solar thermal energy,"* said Weiss.

But this conference also showed that there is still an intensive need for R&D and knowledge dissemination if the market is to grow to significantly – especially in Europe, which is having a challenging time at the moment. With many of Europe's traditional solar thermal markets slowing down or stagnating in recent years, cost competitiveness of solar thermal with fossil fuel and renewable energy solutions with energy efficiency measures were recurring topics throughout the conference. Europe's goal to make Nearly Zero Energy Buildings the building standard by 2021 could provide the needed impetus to make solar thermal a standard building solution in Europe.

In addition to all the official conference sessions, SHC 2013 proved to be a fantastic networking event. The Freiburg Konzerthaus, with its bright and open architecture and its many niches and tables, provided excellent opportunities to meet and discuss. Throughout the conference people could be seen standing in small and large groups talking to each other. And the conference dinner was no different, instead of a formal event the organiser chose to host a walking dinner in Freiburg's famous Market Hall. The evening kicked off with the SHC Solar Award being presented to two representatives of Canada's Drake Solar Landing Company (see page 1 for special article).

The second SHC conference was a big success for everyone attending. For those who missed it – the conference papers will be published in Elsevier's Procedia series!

Join us at SHC 2014 in Beijing, China!

This year's conference is being held in one of the most dynamic, and by far the largest solar thermal market in the world. As the conference organizer, PSE's CEO Andreas Häberle notes, "Many people associate China with very simple, low-cost solar water heaters. But the country is an engine for new developments and they are making big strides in applications, such as solar process heat and solar cooling.

2014 Solar Thermal Trends

As 2014 gets under way, it's important to stop for a moment and think about where solar thermal is heading in the short-term and how current work can support or be adjusted as solar thermal technologies advance. Several SHC Task Operating Agents have weighed in with trends for their areas of expertise.

Compact Thermal Energy Storage

1. Growing interest in the application of compact thermal energy storage for increasing the flexibility of electricity networks.
2. Realization of a number of storage prototypes in EU funded R&D projects, plus in some national projects.
3. Completing of first version of a compact thermal storage materials database.

Rating & Certification Procedures

1. Continued acceptance worldwide of the new EN ISO 9806 standard for collector testing.
2. Harmonization of collector certification schemes.

Large Scale Solar Heating and Cooling Systems

1. Larger and larger solar district heating systems in in Denmark.
2. Increased understanding that interaction between heating grids and electricity grids assist integration of large share of renewable electricity and renewable heating.
3. Large solar systems in some parts of the mining section will most probably soon have a breakthrough

Advanced Lighting Solutions for Retrofitting Buildings

1. Lighting Systems and SSL (Solid State Lighting):
    - Increasing efficiency of solid state lighting (SSL)
    - Further reduction in (investment) costs
    - Increasing quality and acceptance of light management solutions
2. Standards, Regulation and Certification:
    - New and enhanced methods and approaches
    - Increasing relevance of certification systems
3. Retrofit of lighting installations:
    - Increased focus in countries with rising electricity costs
    - Increasing interest due to the above mentioned aspects

Solar Resource Assessment and Forecasting

1. Provision of high quality, reliable, and long-term solar resource data products, derived either from satellite imagery or numerical weather prediction models, continues to move to the commercial sector and away from government agencies. Several new data provision companies have formed recently, and in some cases these small, independent companies are being acquired by larger, more mature companies interested in adding to their renewable energy services portfolio.
2. Governments continue to support R&D activities to improve the solar resource models, but overall government funding support in resource assessment R&D is going down. In 2014 government research will focus on topics such as improving data quality through use of more detailed cloud characteristics atmospheric data such as aerosol optical depths, and on mapping tools.
3. Collection of low-cost yet very high quality bankable data from ground measurement stations is a priority of the industry in order to gain financing for specific projects, and significant efforts are underway to design improved and cost-effective instrumentation and data collection and processing procedures, following agreed-upon international best practices. 2014 will see the establishment of new countrywide solar monitoring networks in several countries around the world.
4. IRENA's Global Atlas will continue to emerge as a mainstay "one stop shop" for allowing practitioners, planners, and researchers to have ready access to quality and reliable resource data, even if the atlas leads the users to private-sector data providers. Other multilateral activities such as the World Bank's ESMAP solar and wind resource mapping program will also gain prominence especially for developing countries and emerging economies.
5. As distributed and central station grid-tied solar systems continue to proliferate around the world, a continuing and growing trend is RD&D through public-private partnerships in developing reliable solar resource forecasts and related solar "fleet" management tools that assist system operators in making the most cost-effective and efficient use of the solar energy being delivered to the electricity network, while at the same time maintaining the highest standards in the quality of electricity services.

Solar and Heat Pump Systems

1. More and more combinations of solar and heat pump enter the market.
2. Ice storage solutions

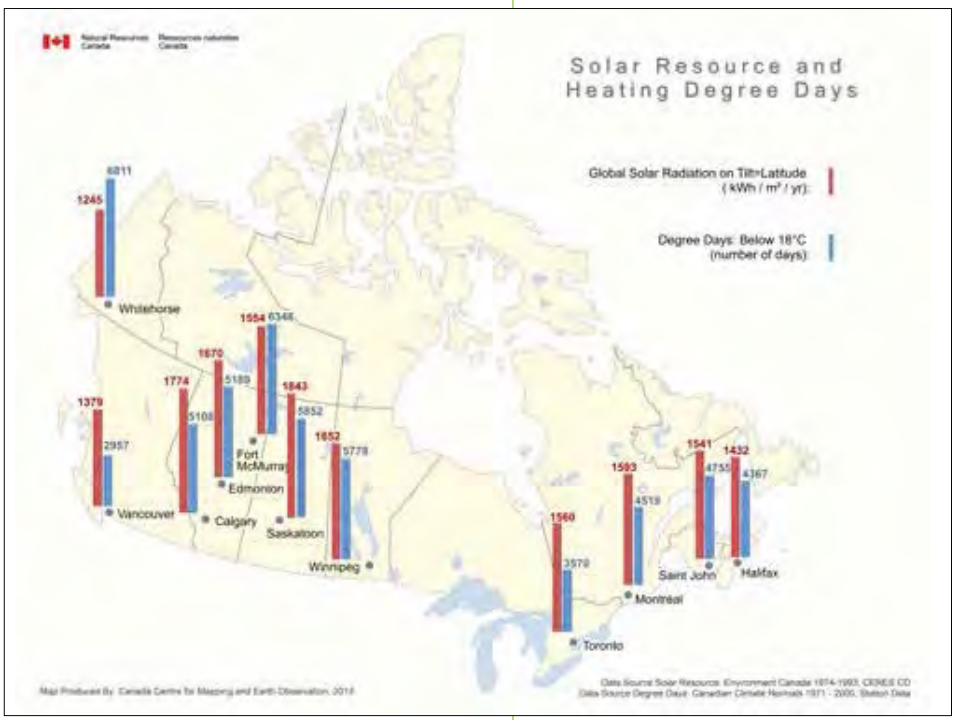
Solar Thermal Has Long History in Canada

It may be frigid in Canada in January, but with an above average solar resource there is significant potential for solar heating products and systems. The application of high solar fraction seasonal heat storage systems for communities is the most recent success story.

Canada has a long history of solar thermal R&D and incentive programs going back to the 1970s and 80s. Most of the solar thermal R&D work has focused on low temperature heating applications (domestic water heating and space heating for both residential and commercial buildings) and low temperature process heating (crop drying for international applications). Several unique solar thermal products and systems also have been developed over the years, including the low flow solar water heater, the transpired solar air collector, and more recently the high solar fraction solar seasonal storage system for communities.

Several unique solar thermal products and systems have been developed over the years, including the low flow solar water heater, the transpired solar air collector, and more recently the high solar fraction solar seasonal storage system for communities.

In Canada, 80% of the residential sector energy use is for heating (63% space heating and 17% water heating) and 54% of the commercial-institutional building sector energy use is for heating (45% space heating and 9% water heating). As a result, there is significant potential for the application of solar heating products and systems. While Canada has one of the coldest climates among IEA countries, it also has an above average annual solar resource ranging from 1400 kWh/m2 in the coastal areas to over 1700 kWh/m2 in the western provinces (see Figure 1).

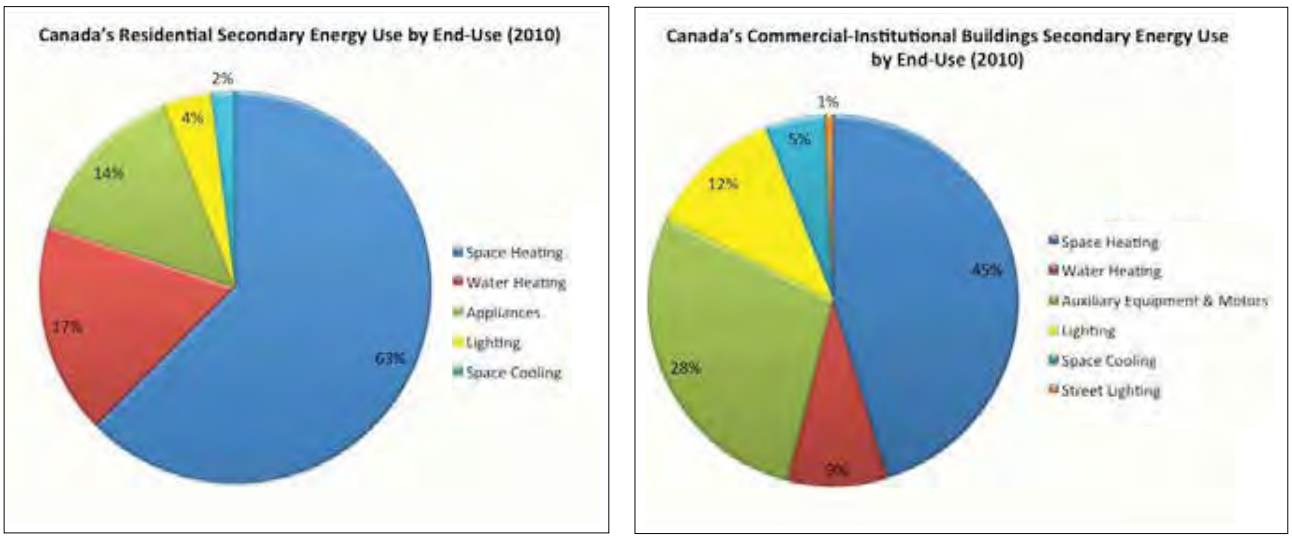


The Solar Thermal Market

Conventional energy prices in Canada have historically been quite low compared to other countries and as a result the market for solar thermal products, outside solar heating for swimming pools, has been strongly dependent on incentive programs. Several incentive programs have been implemented at the national level over the years. A five-year performance based program was in place in the

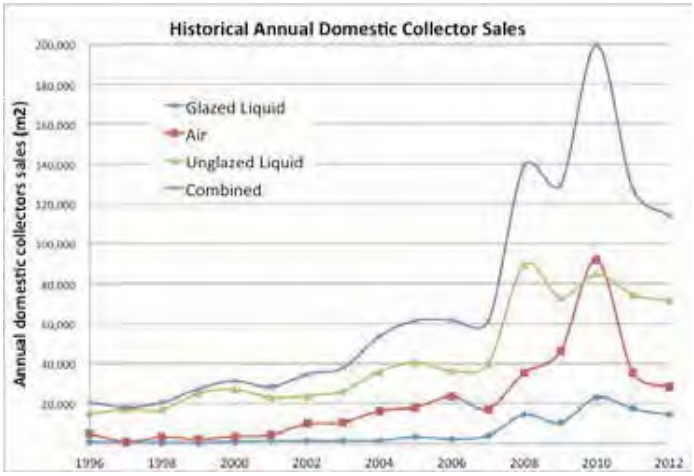
continued on page 7

Canada *from page 6*



▲ **Figure 1. Residential and commercial energy use by end-use.**

1980s. This was followed by ten years without national incentives except for a small number of demonstrations and special pilot projects supported by the R&D program. In 1998 a new incentive program for renewable heating, including solar thermal, was launched that provided incentives based on a percentage of cost for qualified products and systems. This was followed in 2007 by a program based on performance factors. All of these incentive programs have had a positive impact on the solar thermal market in Canada. The products that benefited the most were those closest to being cost-competitive in a low conventional energy price environment, particularly the solar air heating products. Approximately two-thirds of all the solar thermal projects that received national incentives over the past fifteen years were solar air heating systems.



▲ **Figure 2. Annual domestic solar collector sales by collector type.**

Since 1998 there has been a steady growth in the solar thermal industry followed by a period of rapid growth beginning in 2008 with annual solar collector sales reaching over 100,000 m^2 for the first time. And, in 2010 annual sales reached an unprecedented 200,000 m^2 as the national incentive program reached its final year. For the past two years since 2011, without a national incentive program, annual sales have decreased significantly, but remain greater than 100,000 m^2 (see Figure 2)

SolarWall® by Conserval Engineering

SolarWall® by Conserval Engineering

Courtesy of Enerconcept Technologies

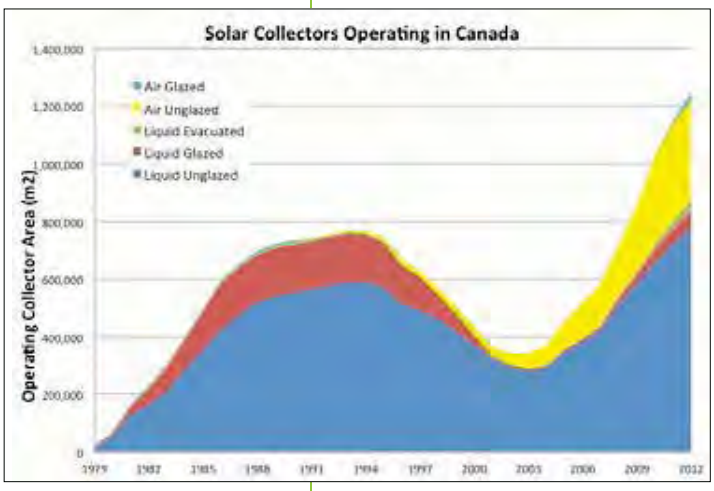
▲ **Figure 3. Examples of buildings integrated glazed and unglazed solar air heating collectors.**

continued on page 8

Canada *from page 7*

Sales and Exports

Most of the collectors that are sold in Canada are unglazed collectors, over 75% in 2012. Unglazed-liquid collectors having the main share of the market with over 60% of the total collectors sold in 2012, followed by unglazed air heating collectors with over 15% of the market share. Unglazed liquid collectors are used primarily for residential pool heating. Conversely, the other liquid collectors (evacuated and glazed) have a more even distribution across both residential and industrial/commercial/institutional (ICI) sectors. Glazed air collectors are used in both the residential and ICI sectors, but that market segment has significantly shifted more towards ICI sectors. Unglazed air collectors are exclusively used for ICI space heating. Examples of building integrated unglazed and glazed collectors are shown in Figure 3.



▲ **Figure 4. Historical overview of operating solar thermal collectors in Canada.**

In 2012, Canada exported over 72,000 m^2 of solar thermal collectors, (up 35% from 2011). This increase in exports may be due in part to the significant decrease in domestic demand (resulting from a loss of incentives) which has driven the industry to look to other markets for sales. The vast majority of exports, similar to 2011, were to the United States. Exports to Latin America have increased to 11% while exports to Europe have dropped to 2%. By collector type, unglazed air collectors were the single largest category of exports followed by glazed air and glazed liquid collectors.

A historical overview of the solar thermal collector area installed and operating in Canada is shown in Figure 4. By the end of 2012, about 1,250,000 m^2 of solar thermal collectors were operating in Canada. It is important to note that with the development of the transpired solar air collector in 1990, solar air collectors have become a significant share of the solar collectors now operating in Canada.

R&D Activities 2012-2016

The current priorities for Canada's national solar thermal R&D program include high solar fraction seasonal heat storage systems for communities, solar air collector performance model validation, evaluation of high performance liquid desiccant solar cooling systems, and harmonization of solar thermal standards and certification programs internationally. At this time, seasonal storage research is the major focus and includes:

- Performance monitoring of the Drake Landing Solar Community,
- Provision of technical support for improvements and controls optimization,
- Dissemination of results nationally and internationally through *SHC Task 45: Large Scale Solar Heating and Cooling Systems*, and
- Evaluation of cost reductions and performance improvements possible for large-scale solar seasonal storage systems for new and retrofit communities in Canada and abroad.

Drake Landing
Smartphone App

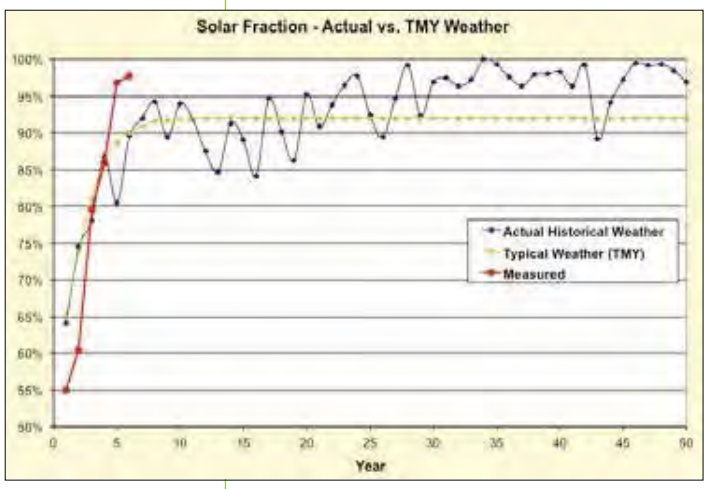
For up-to-date stats on the community's solar energy generation and consumption, download the free mobile app for your phone or tablet.

continued on page 9

Canada *from page 8*

Canada's Flagship Demonstration Project

The Drake Landing Solar Community is Canada's flagship solar seasonal storage demonstration. It is the first solar district heating system in Canada and the first in the world designed to meet more than 90% of the total space heating load with solar energy. Located in Okotoks, Alberta, it operates in a cold prairie climate with over 5,100 heating degree days. Commissioned in July 2007, the solar system recently completed its sixth year of operation, and in that 12 month period met 98% of the heating with solar energy. It uses solar collectors mounted on garage roofs, a borehole thermal energy storage (BTES) for seasonal storage, two water tanks for short-term thermal storage, and a distribution piping loop to supply heat to 52 homes. The solar domestic hot water appliance installed in each home is designed to supply 40-60% of the service water heating load with solar energy.



▲ **Figure 5. The Drake Landing Solar Community is actively monitored and measured performance is very close to design predictions.**

Detailed monitoring has been ongoing since commissioning to allow validation and improvement of the TRNSYS model used for system design and to permit long-term detailed reporting and analysis. The measured performance has generally proved to be very close to the design predictions. The monitoring results have also facilitated control and operation refinements and allowed an improved understanding of system operation for Drake Landing and subsequent projects. For example, lowering the collector and BTES loop pump flow rates can sometimes be used to deliver more useful water temperatures, increase stratification in storage and reduce pumping power. As a result, solar energy delivered to the load in year six was approximately 30 times the total energy consumed for pumping.

The system has proven to be reliable and routine collector glycol testing suggests it will have a long service life. The system has generated a very high level of worldwide interest and recognition, including winning the prestigious Energy Globe World Award in 2011 and the IEA Solar Heating and Cooling Programme Solar Award in 2013. Additional information on Drake Landing, including near real time performance is available at www.dlsc.ca.

This article was contributed by Doug McClenahan, the SHC Canadian Executive Committee member.

Case Study Work Begins on Lighting Retrofits

Task 50

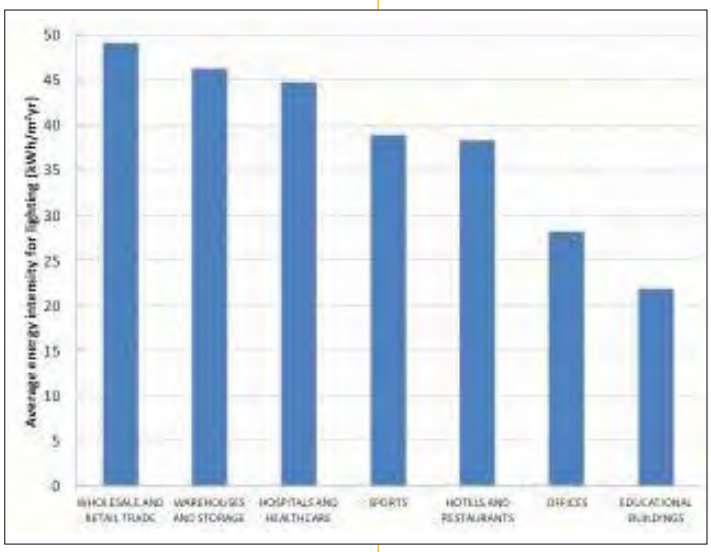
The objective of *SHC Task 50: Advanced Lighting Solutions for Retrofitting Buildings* is to accelerate the retrofitting of daylighting and electric lighting solutions in the non-domestic sector using cost effective, best-practice approaches that can be used on a wide range of typical existing buildings. Following this aim, the collection of case studies is a very effective way to provide and disseminate valuable inspiration, insight and experience from energy renovation projects carried out in different countries and under different constraints. Therefore, case studies are being collected as part of SHC Task 50.

Analysis of building stock distribution

The analysis of the current distribution of the building stock in the non-residential sector by Task experts is being used to define the most important building types. In addition, current average energy intensity for electric lighting for each building type was analyzed as well as the characteristics of the existing lighting installations.

Preliminary results from this analysis show that the non-residential building stock can, by approximation, be characterized by seven dominant building types, all of which will be looked at within SHC Task 50:

1. Offices
2. Educational Buildings
3. Wholesale and Retail Trade
4. Industrial Buildings
5. Hotels and Restaurants
6. Hospitals and Healthcare Buildings
7. Sports Buildings



▲ **Figure 1. Average energy intensity (kWh/m²yr) for lighting for different building types from available data.**

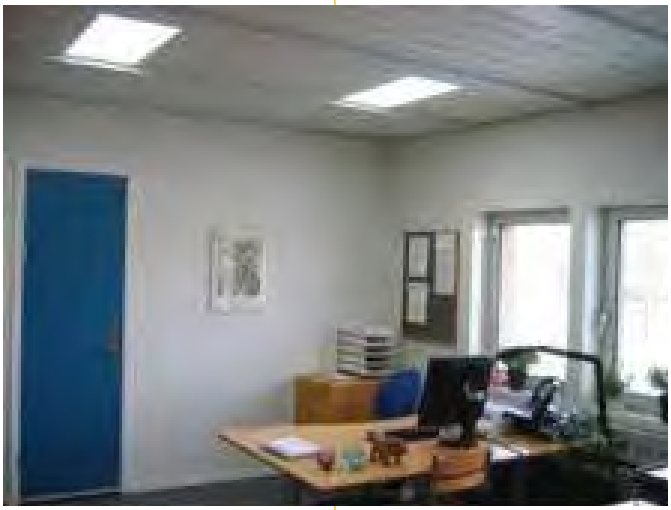
The first four building types each cover roughly 20-30% of the total floor area of the non-residential building stock, the three latter about 2-10%. The analysis also shows that agriculture buildings may be relevant, covering more than 30% of the non-residential building stock in some countries, however, data for this sector is not available in all countries and will not be covered within the Task work.

As shown in Figure 1, the higher energy intensity for lighting is found for wholesale and retail trade, warehouses and storage buildings, and hospitals and healthcare. The results also indicate that fluorescent lighting is the dominant light source in the non-residential sector and that roughly half of fluorescent lamps are of the older type (i.e., T12 or T8 lamps with conventional ballasts).

First Assessment of a Lighting Retrofit in an Office Building – Horsens Town Hall, Denmark

The Town Hall in Horsens, Denmark was retrofitted with new electric lighting. As the majority

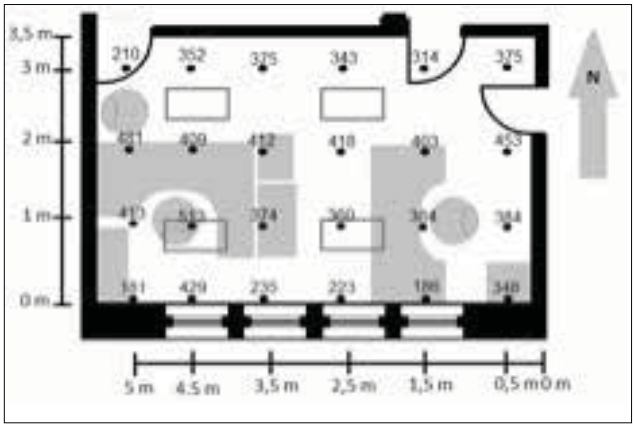
continued on page 11

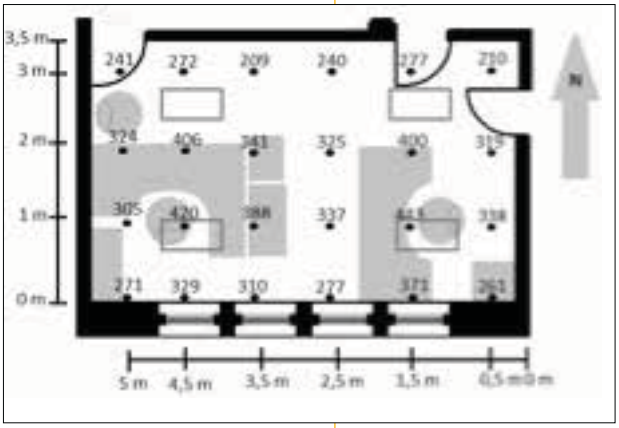


▲ **Figure 2. Office with original luminaires with 2700K T8-fluorescent tubes (left). The same office with the new 5500-6000K LED panels (right).**

of photometric measurements and the first user survey have been completed, preliminary conclusions can already be drawn.

Horsens Town Hall, built in the late 1980s, is a modern redbrick building with approximately 20,800 m^2 of floor area across three main floors of administrative offices and a basement containing archives, a fitness center and technical installations. A lighting retrofit was undertaken because the building windows are small with large window frames creating low daylight illumination levels and electric lighting is needed for the majority of annual occupancy hours.





▲ **Figure 3. Plan of 2-person office with illuminance values from fluorescent luminaires (left, measured on 27 November 2012) and from LED panels (right, measured on 17 December 2012). The light-grey rectangles indicate the position of the luminaires in the ceiling.**

The first step in the retrofit was to gradually replace the original 2x 18W T8-fluorescent lamps at 2,700K with magnetic ballasts in ceiling-recessed and louvered luminaires with 2x 10W LED tubes at 6,000K as the budget allowed. Incandescent lamps in some offices, the foyer and outside the building were replaced with either compact fluorescent or LED lamps.

Early measurements in the converted offices revealed that the LED tubes reduced not only the energy consumption, but also the illuminance levels by 40 to 50%. This was not the intention. A decision was made by the city of Horsens to replace the luminaires and lamps with new 26W LED panels at 5,000-6,000K. The shift to LED panels took place during the fall of 2012. Luminaires were also replaced more strategically in relation to workplaces. The LED panels were placed in two rows, one near the windows and one away from the windows, with respective manual switches on separate circuits (Figure. 2).

continued on page 12

Before and after the lighting retrofit, illuminance distribution over a regular grid was measured in a number of representative office spaces. As depicted for a sample office in Figure 3, the average illuminance level from electric lighting alone was higher with fluorescent lighting than with LED lighting, but in return, the distribution was more even with the LED panels.

After about half a year with the new lighting, a questionnaire was sent out to the staff at Horsens Town Hall, in which they were asked about their experience and satisfaction with the lighting before and after the lighting retrofit. Of the 182 of about 550 employees that responded, the majority felt that the light level had increased after the switch to LED panels. This is most likely due to the fact that light is often perceived to be brighter when it has a higher color temperature. A more even light distribution and more light on the upper walls and ceilings could perhaps also result in a higher perceived illuminance level. Before the retrofit, there was a tendency that staff experienced the lighting level as a bit too dark (43.9%). After the retrofit, 61.7% assessed the lighting level in general as comfortable, while 27.9% stated that it was too bright.

Some employees experienced more flicker after the change to LED panels. Measurements in the laboratory showed that the LED panels produce just as much flicker as the old fluorescent lamps with magnetic ballasts, likely due to an unsuitable combination of LED sources and driver. When the LED panel was connected to an external power source there was no flicker at all.

Of the respondents, 89.7% rated lighting quality as important or very important for their work performance. And, 90.5% felt that the shift from T8 fluorescent tubes with 2,700K to LED panels or tubes with 5,500-6,000K had not changed their perceived productivity while 8.3% believe that their productivity has increased and 1.4% believe it had decreased since the introduction of the LED panels. This suggests that the shift to LED sources has overall been perceived as positive with respect to work performance. A follow-up survey in December 2013 will try to ascertain whether this is still the case one year after completing the retrofit and during winter, when lower daylight levels again increase the need for electric lighting.

Preliminary Case Study Conclusions

The research on Horsens Town Hall will continue with a more detailed look at the responses to the initial user survey, a follow-up survey and its evaluation, further measurement periods and additional computer simulations, especially with respect to potential improvements for daylighting and control systems for shading devices and electric lighting. Nevertheless, the following preliminary conclusions can already be derived:

- Experienced professional lighting designers, in addition to the electrical consultant, should have been involved in this project from the very start. This would likely have resulted in even better solutions without the original detour involving LED tubes.
- Energy savings and a reduction in CO_2-emissions of about 65% are expected in this case study. Actual figures for the first year of operation still need to be compiled and analyzed.
- First evaluations of the initial user survey indicate an improvement of the indoor environmental quality, resulting in higher satisfaction and perceived productivity of the building's occupants. The intended more detailed analysis of the survey data and follow-up studies might reveal some simple indicators for this.

The results of and knowledge gained from this project as well as from other projects will eventually be included in the Lighting Retrofit Adviser, an electronic sourcebook, where lighting designers and clients can find inspiration and advice. This tool will include and present all results from SHC Task 50.

This article was contributed by Marie-Claude Dubois of Lund University, Sweden; Sophie Stoffer and Werner Osterhaus of Aarhus University, Denmark; Anna Hoier and Jan de Boer of Fraunhofer Institute for Building Physics IBP, Germany.

To learn more about this work visit the SHC Task 50 webpage or contact the Task Operating Agent, Jan de Boer, jdb@ibp.fraunhofer.de

The collection of case studies is a very effective way to disseminate valuable inspiration, insight and experience from energy renovation projects carried out in different countries and under different constraints. SHC Task 50 will use case studies to demonstrate sound lighting retrofit solutions – energy savings, lighting quality and operational costs.

JAN DE BOER
SHC Task 50 project leader

Survey on Solar Radiation Monitoring Requirements

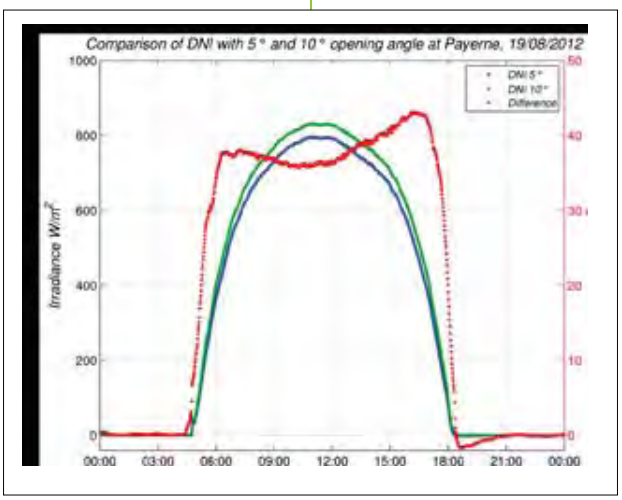
Task 46

▲ **Figure 1. The Payerne test bench showing the instruments being tested during the performance evaluation.**

In the solar energy sector, radiation measurements are needed for resource assessment, performance evaluation and monitoring, solar plant production optimization, grid operation, and forecasting. Measurement errors, however, can have serious consequences depending on the application. One very consequential error that can occur is the overestimation of the available resource during the planning stage of a solar energy system. An overestimation can result in largely reduced profit margins. Today, solar resource assessments mainly rely on satellite or model-derived data sets, but to validate these and adapt them to local conditions, solar radiation measurements are essential.

Global radiation, which is the main input to calculate yields of flat plate collectors, is less critical, but diffuse and direct radiation is more challenging to measure. More and more concentrating solar technologies, for example for higher temperature process heat, that are being rolled out require Direct Normal Irradiance (DNI) as an input for the yield calculation. Therefore, the demand for DNI measurements is rising and in the past several years new instruments have been developed to derive DNI.

For a better understanding of the newer types of instruments, MeteoSwiss conducted a performance evaluation of solar radiation monitoring instruments that allow separating the direct and diffuse components without requiring sun trackers. This performance evaluation was conducted over 15 months from June 2012 to September 2013 at the Payerne observatory in Switzerland, which is part of the Baseline Surface Radiation Network (BSRN). This activity has led to a better understanding of the instruments' performances and is helping to determine relevant best practices and standards.



▲ **Figure 2. Comparison between direct normal irradiances measured by a regular pyrheliometer with a 5° opening angle by an instrument with a 10° opening angle. This day was characterized by a high aerosol load (Saharan Dust Event), which produces a strong aureole around the sun resulting in a significant difference between the two measurements. An even larger difference would have been obtained if comparing a regular pyrheliometer and an instrument with a smaller opening angle (e.g., 2°). Such effect should be taken into account when monitoring DNI for concentrating technologies.**

To support this activity, you are invited to participate in a short survey of users' requirements and needs for monitoring radiation. The online questionnaire (www.dni-quest.ch) focuses on the solar energy community with an emphasis on direct solar radiation. Its goal is to help providers of meteorological services and radiation observation technologies better understand the needs of different users in the solar energy value chain. The questionnaire results will be published as part of a report on radiation instrument performances by COST Action ES1002 WIRE.

This is an opportunity for the users of meteorological services and observation technologies in the solar energy sector to give their input about their needs and requirements. Different providers of services, such as consultants and instrument manufacturers have expressed a keen interest in this activity. And, users can now indicate if there are requirements currently not being met and what the most important aspects of radiation monitoring are for them.

Please consider completing the online questionnaire http://www.dni-quest.ch.

This article was contributed by SHC Task 46/SolarPACES Task V experts, L. Vuilleumier of MeteoSwiss, Payerne, Switzerland and R. Meyer of Suntrace GmbH, Hamburg, Germany. For more information on this and other solar resource work visit the SHC Task 46 webpage and the COST Action ES1002 WIRE website.

Solar + Heat Pump Combinations Increase Performance

Task 44

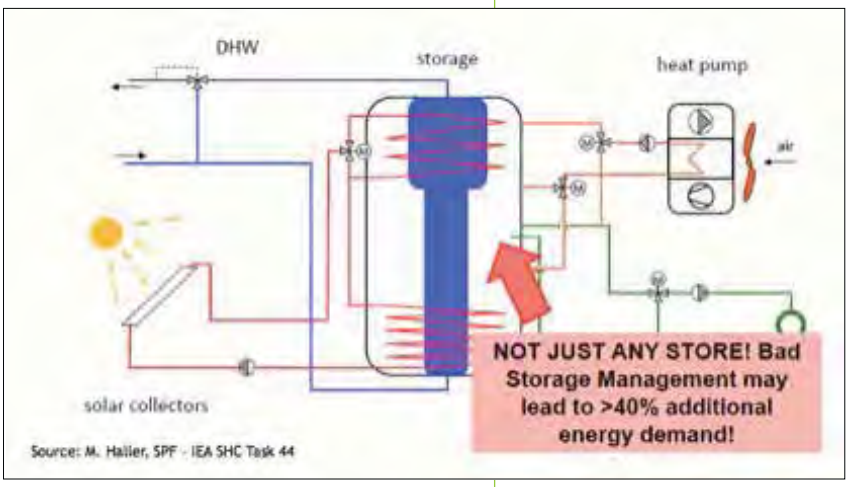
For the past four years *SHC Task 44: Solar and Heat Pump Systems* experts have investigated all combinations of solar and heat pumps with the end goal of contributing to the heat demand of low energy houses. By collaborating internationally and with the IEA Heat Pump Programme, participants have worked to assess the performance and relevance of combined solar thermal and heat pump systems with the end goals to provide a common performance definition and to contribute to the successful market penetration of these promising new systems. To narrow the scope of work, SHC Task 44 has focused on domestic hot water and heating systems in single-family houses – small systems in the range of 5 to 20 kW that use any type of solar collector.

One aspect of the work is monitoring several installations. One of these installations was highlighted in Issue 58 of the *Solar Update* – a system that uses an ice storage solution, which is a promising technology to improve performance where air is the only available source for the heat pump.

The monitoring data also have been used to validate simulation models. These and other results will be available for free on the SHC Task 44 webpage later this year. And a handbook, *Solar and Heat Pump Systems*, will be published the end of 2014. The book will be part of the SHC book series published by Wiley-VCH publishers.

Within SHC Task 44 relevant data, experiences and knowledge on the topic were collected from the 13 participating countries. Conclusions drawn from the monitored installations, simulation work and laboratory testing, include:

1. As foreseen when the Task began, combining solar and heat pump systems is not straightforward. There are decisions to be made on the best hydraulics scheme, the control strategy and the position of inlets and outlets in the storage tank, all of which can positively (or negatively) impact the performance of the combination. A hybrid system needs lots of optimization!



▲ **Solar and heat pump combinations need optimization.**

2. The hybrid technology, when properly designed, has the potential to noticeably increase the Seasonal Performance Factor (SPF), to reduce accordingly the primary energy demand of a heating system, and to lead to a high renewable energy share for all kinds of heating loads. These two technologies can be attractively combined to improve performances at a reasonable cost.

3. Due to the complexity of hybridization, simpler systems, where solar and heat pump systems are working in parallel, dominate the market today and probably will do so for the next several years.

4. Component testing, system simulations, system testing and installation monitoring are still needed and should be included in any policy strategy, at least for single-family houses.

An official and broadly accepted "efficiency certification" or labeling system is needed if there is to be a clear comparison of these hybrid systems.

continued on page 15

Solar + Heat Pump Combinations *from page 14*

5. There is still no clarity on which hybrid systems are performing well and how well. The manufacturer declarative statements are the only source of information. SHC Task 44 has brought to light some lower than expected results as well as some very promising results. SPFs have been recorded from 2.8 to 4.3 for solar and air heat pumps and from 2.1 to 6.5 for solar and geothermal heat pumps.

6. A unified system test cycle is necessary and standards should aim at defining this test soon. SHC Task 44 and EU projects are paving the way.

7. An official and broadly accepted "efficiency certification" or labeling system is needed if there is to be a clear comparison of these hybrid systems.

This article was contributed by Jean-Christophe Hadorn of Base Consultants, Switzerland and the Task 44 Operating Agent.

COUNTRIES PARTICIPATING IN SHC TASK 44: SOLAR & HEAT PUMP SYSTEMS

Austria	Italy
Belgium	Portugal
Canada	Spain
Denmark	Sweden
Finland	Switzerland
France	USA
Germany	

Marketplace

The Solar Heating and Cooling Programme is not only making strides in R&D, but also impacting the building sector. This section of the newsletter highlights solar technologies that have been developed or conceptualized in a SHC Task and are now being commercially manufactured, marketed or used.

Göss Brewery – A Benchmark for Best Practices

One of the topics within *SHC Task 49: Solar Heat Integration in Industrial Processes* is the identification and further development of new applications for solar heat in industrial production. Under the framework of the EU's Seventh Framework Programme (FP7) SolarBrew project, which is coordinated by the SHC Austrian company AEE INTEC, three new solar thermal applications are underway at production sites of the Heiniken Group. In Spain, solar heat will be used for a bottle pasteurizer, in Portugal for drying malt, and in Austria for the mash process.

The "Green Brewery" project in Göss, Austria at Brau Union Österreich (member of the Heiniken Group) is a pioneer in the development of CO_2-neutral brewery in Europe. And in September 2013, the company celebrated one more milestone – the official start-up of the new solar plant, which occupies an area of around 1,500 m² and will generate part of the heat required for the brewing process in the brew house. The Göss brewery is being converted into the leading green brewery in Europe. Around 40% of the brewery's heat requirement is met from waste heat discharged from a neighboring sawmill and 90% of the waste heat generated in the brewing process is used to heat water. At the beginning of this year, a new boiling system was introduced in the brewing process that helps save just under 200,000 kilowatt-hours of power and over 6,400 m³ of water per year. In addition, the new solar plant will make an immediate contribution to the generation of environmentally friendly energy. The project partners include AEE INTEC, Sunmark A/S and GEA Brewery Systems GmbH. The new solar thermal plant was co-financed by the Austrian Government's Climate and Energy Fund and supported by additional EU funding under FP7.

For more information on this and other projects visit the SHC Task 49 webpage.

Solar Thermal – A High-Tech Renewable Energy with Great Performance!

This database illustrates that the core element of a solar thermal installation–the collectors –can be aesthetically integrated within a building's envelope or mounted on the building. End users can benefit from both the pay back on their investment and the attractive, high performance solar installation.

Scroll through these architecturally aesthetic solar thermal installations on the SHC Task 39: Polymeric Materials for Solar Applications webpage.

SHC Publications

Don't miss reading, using and referencing these important SHC publications and databases.

SOLAR RENOVATION IN NON-RESIDENTIAL BUILDINGS

Exemplary Renovation Projects

This set of case studies demonstrates that total primary energy consumption can be drastically reduced while also improving the building's indoor climate. The projects have been systematically analyzed to make them a reliable resource and case studies continue to be added to the collection.

SOLAR AND ARCHITECTURE

Innovative Solar Products for Architectural Integration

This user friendly website showcases innovative/inspiring solar products for building integration on the market. Products for photovoltaic, solar thermal, and hybrid systems are included. The user simply chooses a specific technology and integration approach (roof integration, facade integration, balcony, etc.) and then is provided with a selection of appropriate products in "virtual sheets." These sheets include detailed product information, contact details, and pictures of the stand-alone product and its application on buildings. To ensure that this is a "living" site, the data continues to be updated.

Designing Photovoltaic Systems for Architectural Integration: Criteria and Guidelines for Product and System Developers

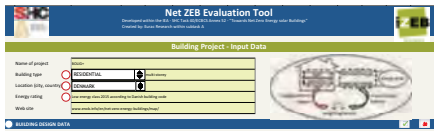
A report written for manufacturers of photovoltaic systems to help with the successful integration of PV systems in buildings. The report includes a proposed methodology for the design of systems specifically conceived for building integration. For each specific sub-technology, it provides a comprehensive set of practical recommendations that should lead to the production of new systems appealing to architects.

Solar Energy Systems in Architecture: Integration Criteria and Guidelines

A report written for architects to provide clear and practical information on integrating active solar technologies (solar thermal and photovoltaics) into buildings. The report covers both architectural integration issues and energy production requirements, and includes a section on the differences and similarities between solar thermal and photovoltaic systems to help architects optimize the energy use and architectural design of the sun exposed surfaces of their buildings.

NET ZERO ENERGY SOLAR BUILDINGS

Evaluation Tool for Net Zero Energy Buildings



This excel-based tool can assess balance, operating costs and load match index for predefined Net ZEB definitions. The tool supports the evaluation of solutions adopted in new building design with respect to different Net ZEB definitions (for building designers), assessment of the balance in monitored buildings (for energy managers), implementation processes of Net ZEBs within the national normative framework (for decision makers).

LCE Analysis of Buildings: Taking the Step Towards Net Zero Energy Buildings

This technical paper analyzes the embodied energy where the focus is on the impact on the total life cycle energy use when moving from a low energy building to a Net Zero Energy Building. It also highlights the important parameters in the context of a life cycle energy analysis.

SOLAR COOLING

Solar Cooling Position Paper & Executive Summary

This Position Paper presents an overview of the state-of-the-art of the solar cooling and air conditioning technology and markets, and discusses the technology's shortcomings and how to overcome them.

LARGE SCALE SOLAR HEATING AND COOLING SYSTEMS

Market Overview

This report is an overview of the market´s development over the last 30 years and shows opportunities for further growth and country specific potential for implementing large-scale solar thermal plants.

SOLAR AND HEAT PUMP SYSTEMS

A Review of Market-Available Solar Thermal Heat Pump Systems

This report analyzes the currently available systems. A survey of more than 80 companies, mostly in Europe, shows that most of the systems are used for the combined production of domestic hot water and heat for the space heating circuit.

continued on page 17

SHC Publications *from page 16*

SOLAR RATING AND CERTIFICATION PROCEDURES

Roadmap of Collector Testing and Certification Issues

This reference document serves as a guide to describe the existing collector testing procedures, how tests and standards are applied, and how they relate to certification, identification of gaps, inconsistencies and weaknesses along with approaches to addressing the problems.

White Paper: Low-to-Medium Temperature Collectors

From 2010 through 2012, under the auspices of the EU-funded QAiST (Quality Assurance in Solar Thermal Heating and Cooling Technology) project, 12 laboratories participated in a proficiency test designed to identify the repeatability and conformity of solar testing laboratories results. This paper addresses low to medium temperature solar collector testing. *Annex 1 to White Paper on Low-to-Medium Temperature Collectors*

White Paper: Solar Air Heating Collectors

Although solar air heating collectors have some significant advantages in comparison to liquid heating collectors, their current market share is less than 1% of the global solar collector market. This paper addresses the need for common solar air heating collector standards.

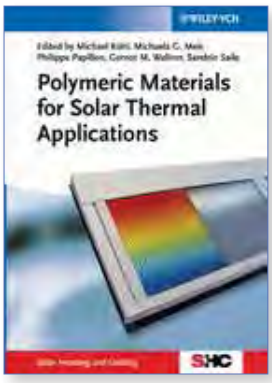
White Paper: Concentrating Collectors

This paper summarizes the work carried out in the field of concentrating and tracking solar thermal collectors. The goal of this work was the introduction and validation of a test method capable of treating concentrating as well as concentrating/tracking collectors with the same accuracy as the current standard treats flat plate and evacuated tubular collectors.

POLYMERIC MATERIALS

Polymeric Materials for Solar Thermal Applications

The first in the IEA SHC Programme's Solar Heating and Cooling book series published by Wiley-VCH. Also, the first



book devoted to polymers for solar thermal applications.

This book, a summation of the work conducted in SHC Task 39: Polymeric Materials for Solar Thermal Applications, comprehensively describes the state-of-the-art of polymers in solar thermal systems and provides an introduction to solar thermal technologies and the polymer properties and processing. It concludes with examples of successful component and system designs for inexpensive mass-produced polymeric solar thermal systems. With its emphasis on applications, this book is relevant for researchers at universities and developers in commercial labs.

Order directly from Wiley-VCH publishers

Newest Member The European Copper Institute

As 2013 came to a close, the SHC Programme welcomed its newest member, the European Copper Institute (ECI). The collaboration with ECI is important for both organizations as copper's combination of high heat conductivity, resistance to atmospheric and aqueous corrosion, strength and longevity make it a key component in solar heating applications. The SHC Programme looks forward to developing fresh, innovative ways to support each others work.

"The partnership with ECI opens the door to collaborate with an organization that is vital to the growth of the solar thermal market."

WERNER WEISS
IEA SHC Chairman

Flying Start for New Work on Global Collector Certification

Task 43

SHC Task 43: Solar Rating and Certification has made significant progress since its start in 2009, especially with respect to solar collector test procedures. A recent major step forward was taken when the new EN/ISO standard for collector testing was drafted. This standard has now been approved by ISO/CEN and is available.

When it became apparent that it was possible to harmonize the European and ISO standards for collector testing, the idea of the global certification of collectors blossomed. This idea was discussed at SHC Task 43 expert meetings and industry workshops and by IEA SHC members – and was well received everywhere. As a result, the SHC work on solar rating and certification has begun to focus its efforts on initiating a global certification scheme. For the next two years experts will collaborate to:

1. Reduce testing and certification costs for the global solar collector industry.
2. Increase quality of solar collector production throughout the world.

The concept for a Global Collector Certification will be executed under an "umbrella concept." Certification schemes that fulfill certain minimum requirements will be accepted under the "umbrella." Collectors certified by a certification scheme that is under this umbrella can then be certified by other certification schemes under the umbrella without any re-testing and re-inspection.

The experts in SHC Task 43 will work to elaborate on the minimum requirements mentioned above and to develop a framework for operating and promoting the Global Collector Certification.

The experts also will support ISO TC180 (Solar Energy) by promoting the new ISO standard for collector test methods in promising solar thermal markets and supporting the development of worldwide-accepted standards for solar water heaters.

SHC Task 43 has had a flying start in this new area of work. Accomplishments to date are:

- Workshop with industry, certificate bodies and test labs.
- Discussion paper: *Proposal for Global Solar Thermal Collector Certification Program*, which is paving the way for a first draft of minimum requirements for the Global Certification Scheme.
- First draft of working rules for the Global Solar Thermal Network.
- Establishing (informal) a Global Solar Thermal Network with the following board officers:
  - Chair: Harald Drück, ITW Stuttgart (Germany)
  - Deputy chair: Les Nelson, IAPMO (United States)
  - Treasurer: Eileen Prado, SRCC (United States)
  - Secretary: Jan Erik Nielsen, Solarkey International (Denmark)
- Signing an "Expression of Memorandum" between IAPMO and Solar Keymark Network, expressing their common interest in working towards global certification in an open and constructive spirit.
- Approval from the CEN Certification Board to work towards mutual acceptance between Solar Keymark and other similar certification schemes.

According to the plan, the following will be accomplished by March:

- Approval of final draft of "Certification Scheme Rules and Minimum Requirements for Certification Bodies."
- Approval of final draft of working rules for the Global Solar Thermal Network.
- Preparation for establishing the Global Solar Thermal Network as a legal body.
- Further progress on mutual acceptance between Solar Keymark and other certification schemes.

For more information visit the SHC Task 43 webpage or contact the Operating Agent, Jan Erik Nielsen at jen@solarkey.dk.

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 50 R&D projects (known as Tasks) to advance solar technologies for buildings. 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

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by

KMGroup, USA

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