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SOLARUPDATE

Newsletter of the International Energy Agency Solar Heating and Cooling Programme

#SolarThermal
#SolarProcessHeat
#SolarCooling
#SolarDistrictHeating

In This Issue

SHC 2017 – International Conference on Solar Heating and Cooling for Buildings and Industry and SWC 2017 – ISES Solar World Congress will be held together in Abu Dhabi and hosted by Masdar Institute. By joining these two conferences you will find the most up-to-date information on renewable energy technology trends and breakthroughs, global and regional policies, and market opportunities all in one location.

The International Conference on Solar Heating and Cooling for Buildings and Industry, SHC 2017, will bring together the latest developments in solar heating and cooling and highlight market successes. SHC 2017 is sure to inspire you as you participate in the conference sessions and discussions and learn firsthand about the developments in the Middle East. It is the goal of SHC 2017 to have you leave ready to help deploy solar thermal technologies to become an increasingly significant contributor to a sustainable and renewable energy future.

The ISES Solar World Congress, SWC 2017, will address the key ingredients of the renewable energy transformation: technology innovation, financial opportunities, policy developments, as well as community and grass-roots actions, case studies and best practices that already are leading towards achieving a 100% renewable energy system in cities and regions. Nevertheless, many challenges remain, and the ISES Solar World Congress 2017 will bring to the forefront a dialogue among diverse experts to discuss and formulate actions to meet these challenges.

Combining both events, IEA SHC and ISES are creating a platform to inspire further innovation and advancements in solar and renewable energy worldwide.

In the coming weeks the first call for participation will be launched. Save the date for this exciting renewable energy event, and follow www.shc2017.org and www.swc2017.org to learn more about abstract deadlines, paper submittal procedures, and the many ways in which you can participate in, and benefit from this conference.

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Opportunities for Action

New SHC Storage Task

2017 means the start of new work on Material and Component Development for Thermal Energy Storage (SHC Task 58). This joint Task with the IEA Energy Conservation through Energy Storage Programme (Annex 33) will focus on four specific areas of work 1) Development and characterisation of storage materials to enhance thermal energy storage (TES) performance, 2) Development of materials testing and characterisation procedures, including material testing under application conditions, 3) Development of components for compact thermal energy storage systems, and 4) Mapping and evaluating the TES application opportunities concerning the requirements for the storage material. What is interesting about this Task is that it will follow two work streams – Phase Change Materials (PCM) and Thermochemical Materials (TCM) – in three of the four subtasks. The kick-off meeting is 5-7 April 2017, location to be determined.

If interested in becoming an expert for your country, contact the SHC Task 58 Operating Agent, Wim van Helden for more information, w.vanhelden@aee.at.

Horizon Prize for a Hospital Using 100% Renewable Energy Sources

The European Union supports research activities to address the Societal Challenge "Secure, clean and efficient energy" through the Framework Programme for Research and Innovation "Horizon 2020". A new initiative has recently been launched to promote innovation in renewable energy technologies: a Horizon Prize for a Combined Heat and Power (CHP) installation in a hospital using 100% renewable energy sources.

The prize, worth EUR 1 million, will be awarded in 2019 to the installation with the best performance in terms of (among others) reliability, integration with the premises and reduction of greenhouse gas emissions. The installation will have operated continuously for at least six months and include storage. The system will cover 100% of the hospital's annual energy needs. The solution will have to include three different European renewable energy technologies.

The Horizon Prize is part of the European Commission's series of "inducement" prizes, which offer a cash reward to whomever can most effectively meet a defined challenge.

You can find more information at:
http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/lce-prize-renewablehospital-01-2016.html

In Search of ST Installers

Looking for solar thermal installers and planners to complete a survey on their business. More information can be found on the SHC Task 54 webpage or by contacting Sandrin Saile, sandrin.saile@ise.fraunhofer.de.

Unlike other projects focused on cost reductions for solar thermal systems, IEA SHC Task 54: Price Reduction of Solar Thermal Systems is tracking savings potentials along a system's entire value chain – cost efficient innovations on the material and component level, design studies, introduction of standardized components, and optimization of non-technical cost factors (e.g., distribution channels, O&M and installation costs). These latter factors are being investigated with the help of this installer survey, which was announced at the SHC Task 54 workshop in Brussels on 25 May 2016.

The Brussels' workshop was held within the framework of the European Solar Thermal Technology Platform's (ESTTP) workshop, "Solar Thermal Energy for Europe" and was jointly organized with the European Solar Thermal Industry Federation (ESTIF). The event attracted solar thermal specialists from industry, research and politics who joined in lively discussions on the challenging goal of SHC Task 54.

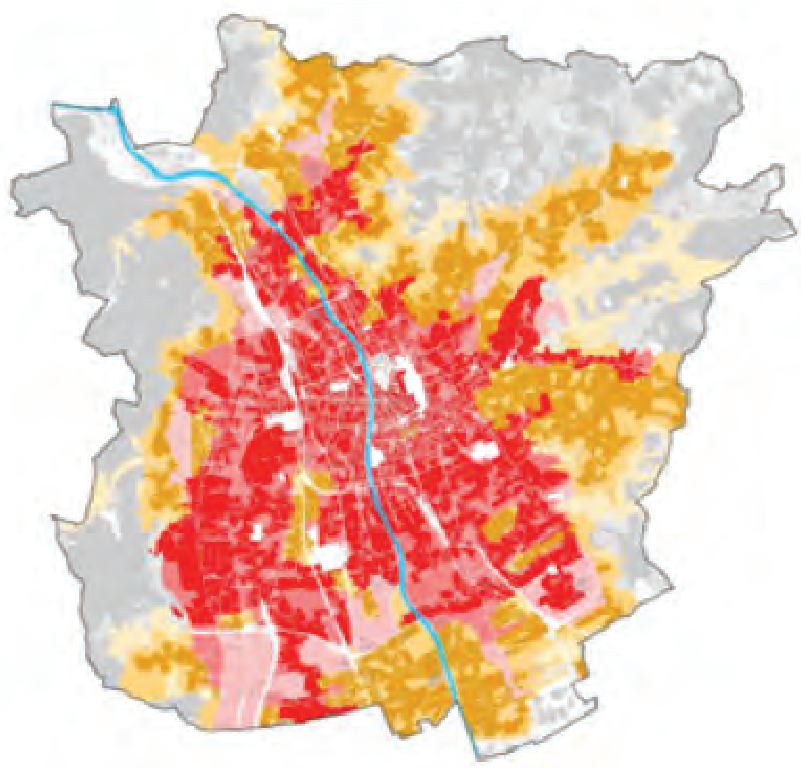
To gain more transparency of the installation effort and to better understand relevant cost structures, the installer survey is a starting point to eventually facilitate installations and support installers in their daily business. "Most solar thermal systems are offered in connection with complex installation sets and specific regulations for piping and connections, which makes the installation effort more difficult than it has to be," Dr. Michael Köhl, Operating Agent of SHC Task 54 explains. And notes that "If we know the specific factors for timely and costly installation, we can consider them in the design of new systems and components," which is one of the many approaches being pursued by the Task's international team of experts.

The survey is available in English, German and French and asks detailed questions on installed system types and models plus questions on the installed sizes and working hours for each installation and on the motives for the choice of one system over another. The survey was launched in September 2016 and will be open until the end of this year.

European SDH Projects – The Next BIG Solar Step

Task 55

Identifying the biggest winners of the late Paris Agreement (COP21) is a challenge, but solar thermal energy, efficient system integration, and network transmission are among the top players, compared to the biggest losers of fossil fuels, oil, and gas. The EU has started to take steps for the first-ever universal, legally binding global climate deal to reduce EU emissions by at least 40% by 2030. However, the successful implementation of large-scale solar thermal plants into district heating networks is often hindered by multiple items arising during the project development process.



▲ **District Heating connections in Graz (red).**

A team of experts from the city of Graz, Austria, has decided to take a lead in the analysis and evaluation of a major proposed local Solar District Heating (SDH) project to determine if it is technically feasible, is feasible within realistic costs, and if it will even be a profitable business opportunity.

The feasibility study "BIG Solar" was conducted in 2015 aiming to evaluate the integration of a large-scale solar thermal system into the district heating network of the city of Graz. Based on extensive modeling, dynamic simulations of the large solar thermal system and its seasonal storages were developed. The study was promoted by the Austrian Research Promotion Agency, the Climate and Energy Fund, the Province of Styria, and the City of Graz. A variety of key topics were identified and elaborated on with a number of collaborative partners. The simulations resulted in a techno-economic optimum of a 450,000 m^2 collector field area, a seasonal heat storage capacity of 1,800,000 m^3 and absorption heat pumps (AHPs) with a total heat capacity of 100 MW. Technical limitations identified were the maximum capacity of the district heating transport line or the current and future heat and temperature loads.

In conclusion, the simulations show that the BIG Solar concept is technically and economically feasible. The economic analysis shows that a heat price is comparable to that of other heating sources of the district heating network in Graz. Although the plant construction has high upfront investment costs, the payback-time is moderate and economically reasonable, even if additional environmental benefits are neglected. Moreover, project parameters on technical and economic simulations are flexible. Given local boundary conditions in Graz, such as the land area available, the collector area of the solar system can vary between 150,000 m^2 and 650,000 m^2.

Still, further studies and assessments are needed and will be conducted to guarantee a detailed economic and technical understanding of the system and its network integration prior to the construction phase.

continued on page 4

Fernheizwerk in Graz is the biggest Solar Thermal installation for district heating in Austria.
Source: © SOID

SHC Task 55: Towards the Integration of Large SHC Systems into DHC Networks will be one platform to elaborate on the economic and technical challenges and opportunities of projects such as BIG Solar in Graz. This new SHC Task aims to facilitate the planning, integration, and operation process of SDH projects into district heating and cooling (DHC) networks to provide standard solutions that can be multiplied globally.

For more information on SHC Task 55 and this project contact the Task 55 Operating Agent, Sabine Putz, s.putz@solid.at.

Results of the Feasibility Study:

- Available land for up to 650,000 m^2 solar collectors and possible locations for storages
- Techno-economic optimum at 450,000 m^2 collector field, 1.8 million m^3 seasonal storage, absorption heat pumps with 96 MW (heat output)
- Flexible size of system with moderate price ranges

INTERVIEW

Advanced Lighting Solutions for Retrofitting Buildings

Interview with Jan de Boer

The IEA SHC Programme wrapped up its work on Advanced Lighting Solutions for Retrofitting Buildings (Task 50) this year, and is developing a new Task on the topic of Integrated Solutions for Daylight and Electric Lighting: From Component to User Centered System Efficiency. To learn first hand about the impact Task 50 has had in this field, we asked Jan de Boer, the Task Operating Agent, a few questions.

Solar Update (SU): Why was this work needed?

Jan de Boer (Jan): Lighting accounts for approximately 19% of the global electric energy consumption. Without essential changes in policies, markets and practical implementations, it is expected to continuously grow despite significant and rapid technical improvements like solid-state lighting (SSL) and new façade and light management techniques. With a small volume of new buildings, major lighting energy savings can only be realized by retrofitting the existing building stock. Many countries face the same situation; about 75% of the lighting installations are considered to be out of date (older than 25 years). Compared to existing installations, the majority of new solutions allow a significant increase in efficiency – easily by a factor of three or more – going along with highly interesting payback times. However, lighting refurbishments are still lagging behind compared to what is economically and technically possible and feasible.

SU: What were the benefits of doing this work thru the IEA SHC Programme?

Jan: We benefitted from an excellent international network of experts. This among

continued on page 5

others allowed us to look into local – partly very different markets – and address their specifics, for instance with respect to the economics of retrofits like electricity and component prices.

SU: What, if any, result surprised you?

Jan: In the field of electric lighting the technology change towards LED went faster than expected and is in many regions of the world now almost completely. Developments for new lighting systems are nowadays almost only done on the basis of LED. SHC Task 50 fell into this period of market transition from fluorescent to SSL (LED) lamp technology. Not only efficiencies increased by nearly a factor of two, but also costs were cut more than in half. This had an impact on energy and economic modelling. We tried to compensate for this with late updates (in parts combined with extrapolations) in the affected activities, while denoting that both efficiencies and prices are now rather in a phase of convergence. Thus, the results and conclusions for this particular field are generally expected to be valid now for a time to come.

SU: What is the most important deliverable(s) of the Task and why?

Jan: Without wanting to highlight one aspect, we can quickly go through the subtasks. We generated a more profound understanding of the financial structure of lighting retrofits by identifying what we called "low hanging fruits" (i.e., retrofits at very beneficial payback times) in the work of Subtask A. In Subtask B, 35 technologies for lighting retrofits were thoroughly analyzed and made comparable to each other, from the façade over light management to the electric lighting solutions. A survey among more than 1,000 practitioners gave a profound view on retrofit approaches being used and shed light on the barriers in practice as well as providing advice for future software development to better tailor future tools to the actual needs (Subtask C). Using a new developed monitoring protocol (on energy, user acceptance, cost) 24 retrofit case studies covering a variety of different building types showed that the energy demand for lighting could be on average cut in about half – giving strong practical evidence that lighting retrofit does significantly lower building energy consumption.

SU: Do you have a success story about a Task deliverable being used by an end-user/industry?

Jan: It's a little too early to tell, but we see for instance initiatives to bring developed approaches (for example, rules to take out dated installations out of order, minimum requirements for new and replacement technologies) into legislation and sustainability discussions. Over the course of collecting the case studies, Task experts supported, with lots of appreciation from the building owners, the retrofit processes and demonstrated the significant potentials with the developed approaches.

SU: How has your Task work supported capacity and skill building?

Jan: Connected to the Task meetings, we had all together 6 workshops with participants from industry, which included manufacturers, designers, and architects. More than 380 people attended the workshops. The Lighting Retrofit Adviser – in our opinion - contains lot of valuable information and methodologies for practical application, but may be used for educational purposes as well.

SU: What is the current status of the technology?

Jan: The electric lighting market remains in a phase of fast technological developments. After costs fell and efficiencies increased, now we are starting to see a phase of adding new functionalities like tunable white concepts, new lighting control schemes. In the field of daylighting, the supply of indoor spaces in retrofits generally can suffer significantly in retrofits, as the preference is most often given to thermal energetic improvement of building shells (low transmittance glazing due to thick insolation systems, thicker window fins and sills). Solutions to counter this are required.

SU: What is the future of the technology – new developments, market, policies needed, etc.?

Jan: Better integration of daylighting and electric lighting solutions is one next big trend for increasing efficiency and better matching lighting to the user's needs. As many studies show, daylight is the user's favorite light source and so it must be protected from a simple substitution or mimicking by low priced electric lighting. A key challenge here is to bring today's mainly independently operating industries – electric lighting, facade, building management – together to cooperate in generating added values.

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

Jan: I sure hope so! We proposed a new Task on integrated solutions for daylight and electric lighting and it is currently in the definition phase. If approved by the SHC Programme in June 2017, the work will get underway soon after that.

SU: Did the Task work on/support any standards?

Jan: Not directly. Nevertheless, we identified specific needs that we're planning to address in the proposed new Task. This will encompass approaches to rate new lighting technologies with respect to energy on a more detailed scale (hourly basis). Plus, further standardization needs in the field of façade photometry are necessary.

Visit the SHC Task 50 webpage to learn more and to download reports, or contact Jan de Boer at jan.deboer@ibp.fraunhofer.de.

Task 50

Improving Lighting Retrofits

IEA SHC wrapped up its lighting project, Task 50: Advanced Lighting Solutions for Retrofitting Buildings, in which experts worked on improving the lighting refurbishment process in non-residential buildings in order to unleash energy saving potentials while at the same time improving lighting quality.

The recent IEA SHC Task on lighting set out to accelerate retrofitting of daylighting and electric lighting solutions in the non-domestic sector using cost effective, best practice approaches that could be used on a wide range of typical existing buildings.
Task participants collaborated to:

- Develop a sound overview of the lighting retrofit market.
- Trigger discussion, initiate revision and enhancement of local and national regulations, certifications and loan programs.
- Increase robustness of daylight and electric lighting retrofit approaches technically, ecologically and economically.
- Increase understanding of lighting retrofit processes by providing adequate tools for different stakeholders.
- Demonstrate state-of-the-art lighting retrofits.
- Develop an electronic interactive Source Book with design inspirations, design advice, decision tools and design tools.

STATUS OF MARKET AND POLICIES FOR LIGHTING RETROFITS

Global Economic Models: TCO and Payback Analysis for Typical Applications

Financial data relative to lighting installations before and after retrofits was generated and analyzed. The data was calculated over many years so as to include the installation costs, maintenance, and energy use. To learn more on this work download the report, *Global Economic Models*.

The general principle was to compare the running costs of a "do nothing" approach (keeping the installation as it is and let it die gradually) and the costs associated with a retrofit with highly efficient equipment.

Long-term costs of an installation are quite sensitive to the initial cost, and the combined cost of electricity and energy efficiency. Therefore Total Costs of Ownership (TCO) of lighting installations were calculated for various types of buildings: offices (see Figures 1 and 2), schools, homes and industrial buildings, and the data was used to address the following issues:

- Which installations are low hanging fruits (with shortest payback time)?
- For which type of building are retrofit operations more profitable?
- How do various parameters influence the payback time (investment costs, efficacy of luminaires and sources, cost of electricity, etc.)?
- In case of high electricity costs, and low cost lighting equipment, duration of payback time is below 5 years, which is attractive since new SSL equipment will operate for 5 to 20 years typically.

"The general principle was to compare the running costs of a "do nothing" approach (keeping the installation as it is and let it die gradually) and the costs associated with a retrofit with highly efficient equipment."

JAN DE BOER
SHC Task 50 Operating Agent

continued on page 7

Lighting Retrofit *from page 6*

- TCO calculations are very sensitive to parameters such as product lighting equipment cost, electricity rates, and annual duration of operation.
- In schools, refurbishment requires very low cost products (installation costs below 10€/m^2) since lighting equipment operates a rather short period of the time.

Building Energy Regulation and Certification

Buildings are designed, constructed and operated in a context of standards, regulations or labels. The normative context of the building concerning energy performance suggests performance indices for lighting installations. Such specifications are not always coherent and consistent with other aspects. For instance, facade window dimension and technologies are directly or indirectly suggested, but optimal performance (daylighting, heat gains, heat losses) cannot always be achieved within the respective codes.

SHC Task 50 conducted a critical analysis of regulation and certification documents to identify some of the possible incoherencies as well as the opportunities for progress, and has proposed some adjustments to these reference documents. You can read more in the report, Barriers and Benefits: Building Regulation and Certification.

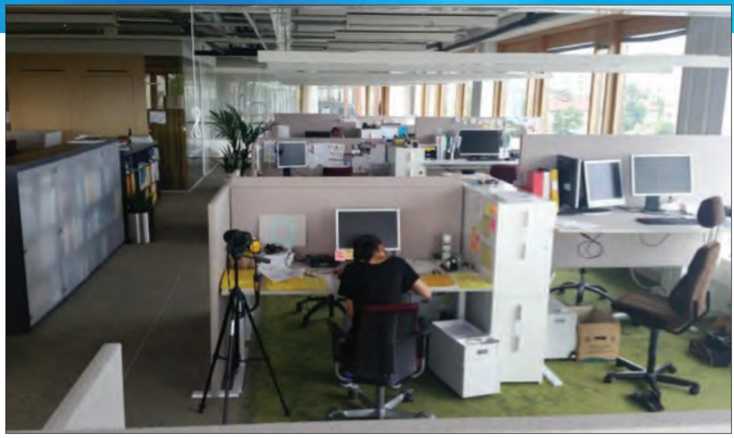
Proposals of Actions Concerning the Value Chain

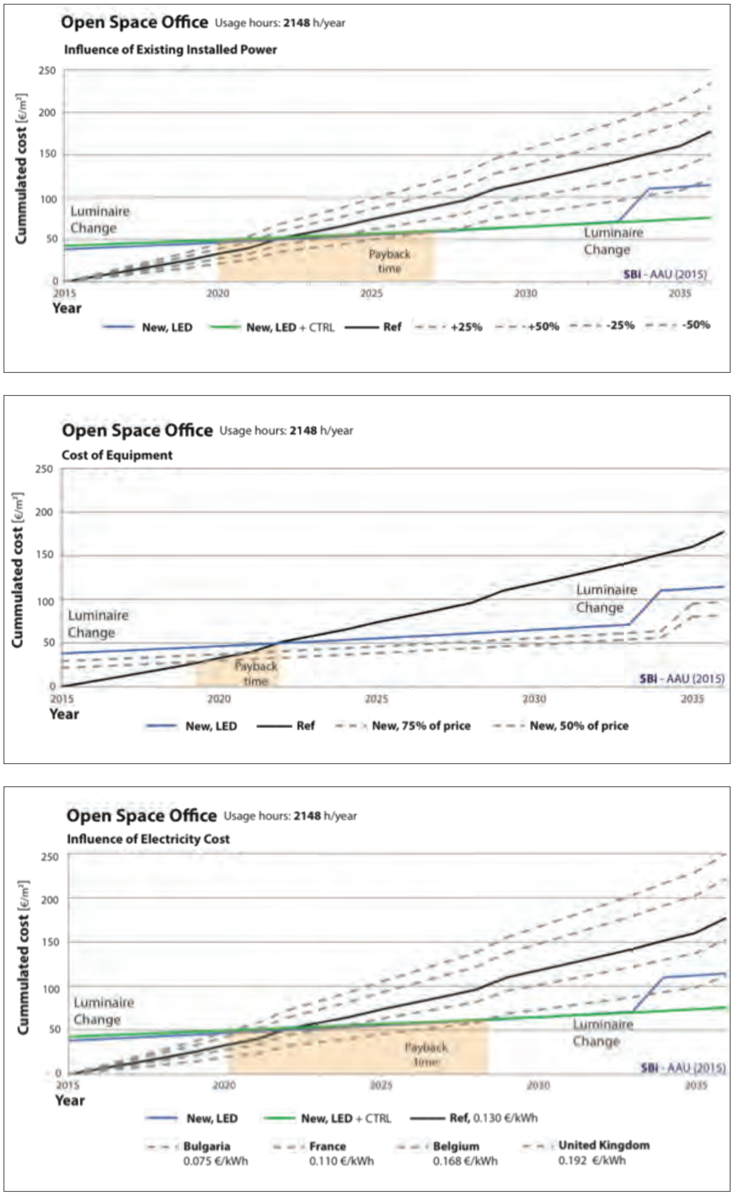
Studies used in SHC Task 50 identified new possible financing options to accelerate replacement of existing installations with financing by the building owner, by an ESCO (assisted by a bank) or by specialized leasing company. From our observations, it seems that the leasing model is the most promising, not only in relation to the added simplicity for the building owner (who does not own the lighting installation or is in charge of its maintenance), but also because it integrates a guarantee of service. It is interesting to note that this new approach triggers a new kind of competition – manufacturers, installers, utilities, facility managers are moving to this field and creating financial pressure on the costs of products, but fortunately, on their reliability and quality as well. Proposal of Actions Concerning the Value Chain.

RETROFIT TECHNIQUES

SHC Task 50 also assessed existing and new technical retrofit solutions in the field of façade and daylighting technology, electric lighting and lighting controls. The main result is the source book, Daylight and Electric Lighting Retrofit Solutions. The source book provides information for those involved in the development of retrofit products or in the decision making process of a retrofit project, such as buildings owners, authorities, designers and consultants, as well as the lighting and façade industry.

In contrast to other retrofit guides, this source book addresses both electric lighting solutions and daylighting solutions, and offers a method to compare these retrofit solutions on a



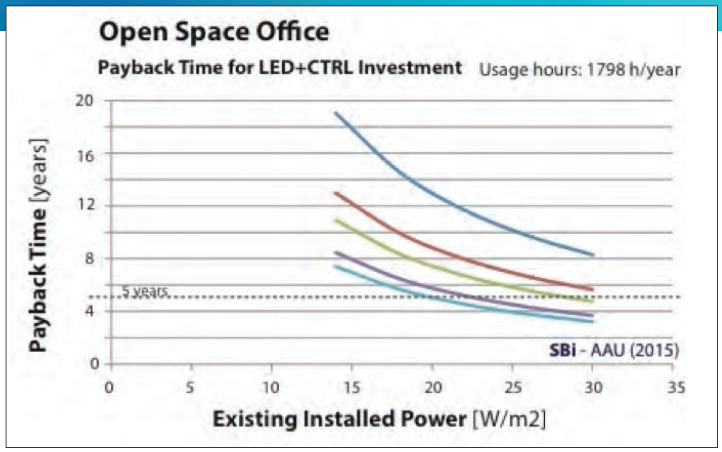


▲ **Figure 1. Cumulated costs for typical open space offices as a function of existing installed power, equipment cost and electricity costs. The same representations were generated, for personal offices, manufacturing halls and wholesale / retail.**

continued on page 8

common basis, including a wide range of quality criteria of cost-related and lighting quality aspects.

Simple retrofits, such as replacing a lamp or adding interior blinds, are widely accepted and often applied because of their low initial costs or short payback periods. The work presented in the book aims at promoting state-of-the-art and new lighting retrofit approaches that might cost more, but offer a further reduction in energy consumption while improving lighting quality to a greater extent. A higher lighting quality can increase health, self-assessed performance, and lead to a higher job satisfaction and thus productivity in the work environment. In this book, the use of daylight is specifically promoted as an optimized daylighting design as the use of innovative daylighting systems are rarely taken into consideration in the retrofit processes of buildings, and daylight utilization both reduces energy consumption for electric lighting as well as increases user well-being.



▲ **Figure 2. Payback time for typical open spaces offices as function of energy price. The same representations were generated, for personal offices, manufacturing halls and wholesale / retail.**

▼ **Figure 3. Possible benefits associated with an improvement of lighting installations.**

	Typology / best solutions	TCO of lighting €/m²	Electricity costs* kWh/m²	Value benefit	Energy benefit	Function benefit	Human benefit
1	**Offices**	36,7 €/m²	11 kWh/m² 1.4 €/m²	2000 €/m²(value) Rental 200-600 €/m² year	2 €/m².yr (lighting) 4€/m².yr (cooling & lighting)	Higher productivity 300€every year is about 1% improvement in productivity or 30 €/m2 is one worker per 10m²	Less stress Extra hours of comfortable work. Check with medical staff. €/m²
2	**Schools**	36,7 €/m²	3 kWh/m² 0.4 €/m²	€/m² (value) €/m² (efficiency of education)	5 €/m².yr	Faster learning 1 % of total costs, including staff (200 €/m²) is 2€/m².	Less stress Higher concentration Extra hours without glare €/m²
3	**Industrial buildings**	14 €/m²	16 kWh/m² 2 €/m²	Rental value	1 €/m².yr	Gains in productivity % of income 3€/m2 if one worker per 100 m2.	Higher comfort Less stress due to daylight Extra hours of comfortable work €/m²
4	**Shops**	36,7 €/m²	33 kWh/m² 4.3 €/m²	> 1% of income	5€/m².yr	Higher % of income	Daylit shopping area, increased attractiveness by customers
5	**Supermarkets**	36,7 €/m²	33 kWh/m² 4.3 €/m²	€/m²	1€/ m².yr	Higher % of income	Daylit shopping area, increased attractiveness by customers €/m²

** calculated for electricity price 0.13 €/kWh*

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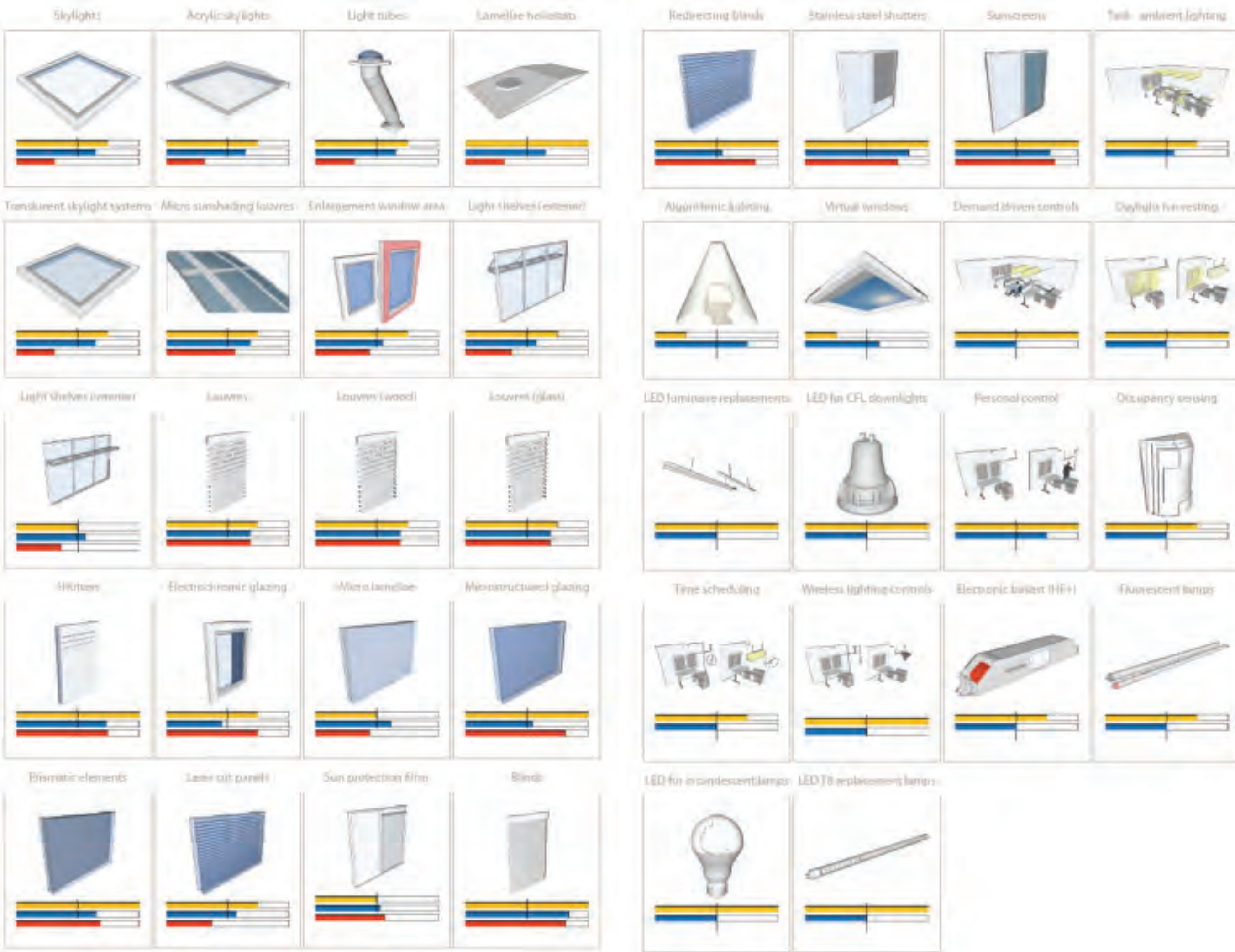
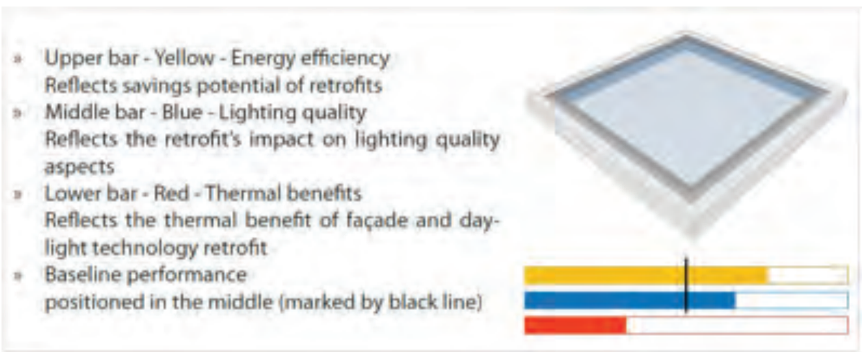




▲ **Figure 4. This overview of featured technologies includes a quick rating system that complements the detailed rating in the Source Book and the Lighting Retrofit Adviser.**

continued on page 10

TOOLS AND METHODS

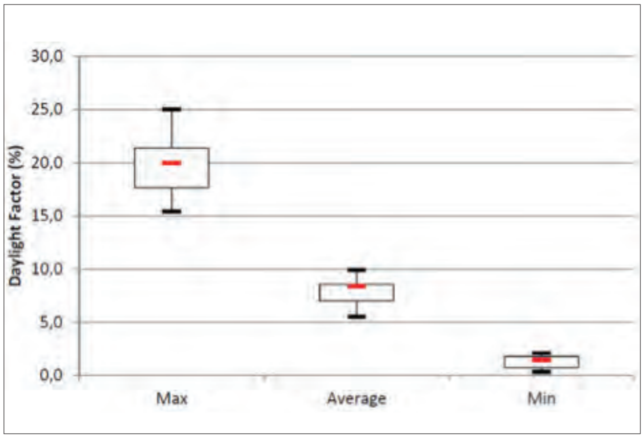
Taking a closer look into the workflows of professionals and the state-of-the-art lighting retrofit tools and methods, the SHC Task 50 participants conducted the following activities.

Lighting Retrofit in Current Practice - Evaluation of an International Survey

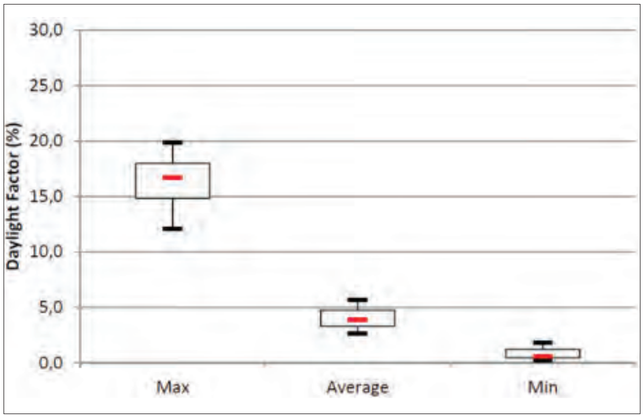
Surveys and socio-professional studies carried out at national and international levels contributed to a better understanding of the lighting retrofit process. The surveys provided clear insights about the workflow of building professionals and led to a better understanding of their needs in terms of computer methods and tools.

One of the main outcomes of the survey is that retrofitting strategies used in practice essentially focus on electric lighting actions, such as of luminaires replacement and the use of controls. Generally, daylighting strategies are not rated as the highest priority. The results also indicate that practitioners mainly rely on their own experience and rarely involve external consultants in the lighting retrofit process. Furthermore, the survey results suggest that practitioners are interested in user-friendly tools for quick evaluations of their project that provide a good compromise between cost and accuracy and produce reports that can be directly presented to their client. The survey also emphasized that the main barriers in using simulation tools are essentially their complexity and the amount of time it takes to perform a study. Practitioners are keen to use tools during the preliminary design stage and would like to be able to estimate the cost and other key figures (energy consumption and lighting levels). From the survey, recommendations for the building software developers to address the needs of practitioners in a more suitable way were deduced.

Before Retrofit



After Retrofit



▲ **Figure 5. Exemplary results from the state-of-the-art review of 13 simulation tools. The graphs above show the calculated daylight factors for a test scenario before and after retrofit. The general drop of the daylight factor due to lower light transmittance of new glazing systems (due to low coating) is shown. Plus, the review shows quite a significant spread in the calculation results.**

Methods and Tools or Lighting Retrofits - State of the Art Review

A review of the state-of-the-art of the methods and tools available on the market to support practitioners in the process of lighting retrofits was conducted. As a starting point, the most used software was taken from the above-mentioned survey. The methods and tools were categorized in four categories:

1. Facility management tools (global diagnostic tool including economic aspects)
2. Computer-assisted architectural drawing / Computer-aided design tools
3. Visualization tools
4. Simulation tools

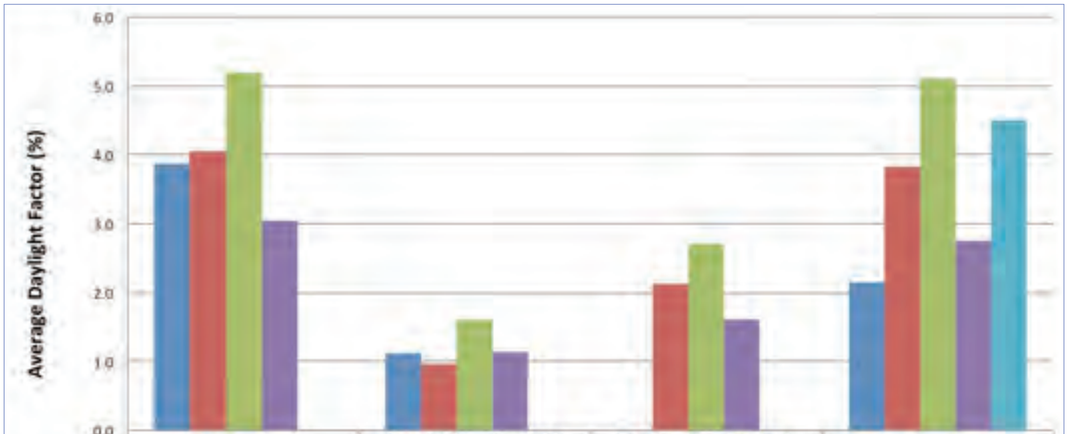
In total, 20 software tools were described and their main features compared for a quick reference. Results (see Figure 5) indicate a rather large dispersion for daylighting results between the different tools even though the case study was described with great care. However, on electric lighting the results remain within the 10-15% range from the median value. The obtained results indicate that practitioners can rely on illuminance values computed by the tools for nighttime, but that the combination of

continued on page 11

daylight and electric light remains a challenge for simulation tools.

Advanced and Future Simulation Tools

This study, Advanced and Future Simulation Tools, looked at software that is able to simulate Complex Fenestration Systems (CFS) composed of solar shading and daylight redirection systems. These systems can have complex light transmission properties named Bidirectional Transmission Distribution Functions (BTDF) that is monitored using goniophotometers or simulated using retracing tools. The results showed a large discrepancy in the results for the daylight factor values, indicating the difficulty to simulate daylight likewise in the state of the art review (as described above).



	Double clear glass	Double clear glass with diffuse blinds	Double clear glass with vertical blinds	Laser Cut Panel
DIALux evo	3.9	1.1		2.1
FENER	4.1	1.0	2.1	3.8
Geronimo	5.2	1.6	2.7	5.1
Radiance	3.0	1.2	1.6	2.8
ReluxPro				4.5

▲ **Figure 6. Daylight Factor obtained with different advanced simulation tools for four different complex fenestration systems.**

The renderings with sunny conditions let the user of the tools appreciate the deviation effect of the laser cut panel for instance, but the obtained images are bound to the intrinsic resolution of the monitored BTDF, which may be coarse depending on the source of data. The advanced and future simulation tools can give an interesting indication of the light distribution through CFS, but practitioners should remain aware of the limits of the method using monitored data bound to a defined resolution. The results are satisfactory enough to get an idea of illuminance profiles or even heat transmission, but not for tasks that require a precise luminance distribution, such as with a glare index calculation.

LESSONS LEARNED FROM 24 CASE STUDIES

A new monitoring protocol developed for non-residential buildings retrofitted with electric lighting and/or daylighting, Monitoring Protocol Lighting and Daylighting Retrofits, was applied to 24 non-residential buildings in 10 countries (see Figure 8). These case studies are presented with monitored data and key conclusions in the Task 50 *Lighting Retrofit Adviser*.

Main conclusions from this work include:

- Cross analysis showed that the energy demand for lighting could be cut on average by 50%. Before retrofit the average energy demand was at 27,1 kWh/m^2 after retrofit it dropped to 14,3 kWh/m^2
- All retrofits monitored achieved improvements in either energy efficiency or lighting quality or both. Replacing older fluorescent with appropriate LED lighting systems can lead to substantial energy savings for electric lighting. Lighting quality and user satisfaction can also be improved at the same time by providing better visual conditions in the spaces. It is, however, not recommended to just replace fluorescent tubes with LED tubes in existing luminaires.
- Control systems for electric lighting or solar shading devices, are frequently found to be poorly implemented, calibrated or commissioned, or perhaps too complex, resulting in reduced energy savings, annoyance of users or even in complete deactivation of the

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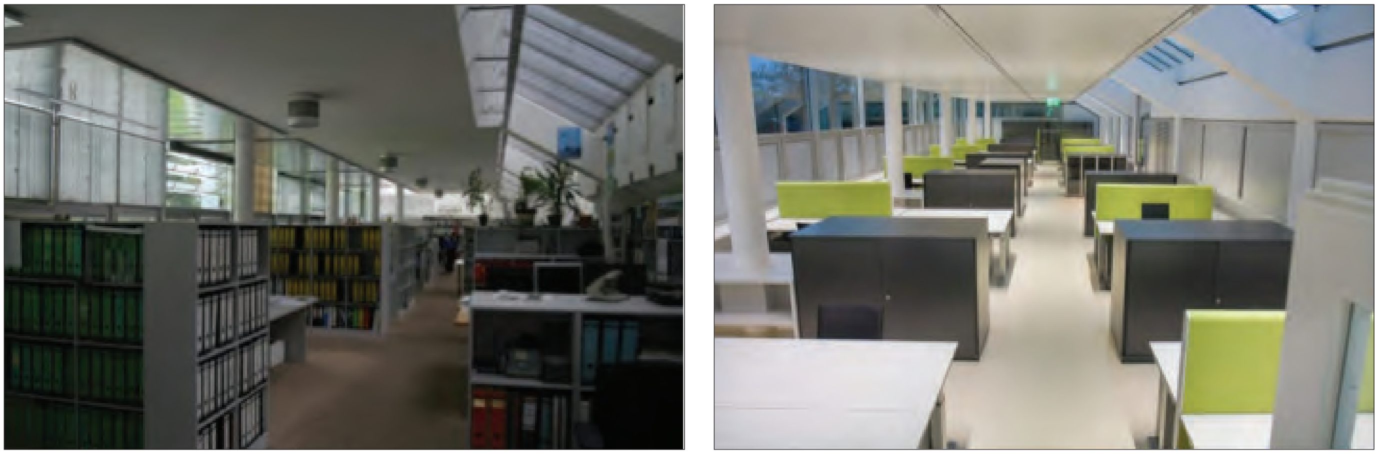


▲ **Figure 7. Pre- and post-retrofit of the Bartenbach R&D office in Austria.**

control system. This highlights the need for better guidance on the installation, commissioning and operation of lighting control systems.

- In general, the users prefer to have the possibility to manually override of the control system.

This article was contributed by Jan de Boer of Fraunhofer Institute for Building Physics and Task Operating Agent for IEA SHC Task 50: Advanced Lighting So-lutions for Retrofitting Buildings, jan.deboer@ibp.fraunhofer.de; Marc Fontoynont, Aalborg University, Denmark; Martine Knoop, Technische Universi-tät Berlin, Germany; and Bernard Paule and Jérôme Kaempf, Estia SA / kaemco LLC / EPFL, Switzerland. Marie-Claude Dubois, Lund University, Sweden.

▲ **Figure 8. Lighting retrofits installed in the 24 case studies.**

The Lighting Retrofit Adviser

The *Lighting Retrofit Adviser* (LRA) is an integrative, comprehensive, multi-platform (desktop / mobile) tool for stakeholders involved in lighting retrofits, and draws on the main results of the different SHC Task 50 subtasks.

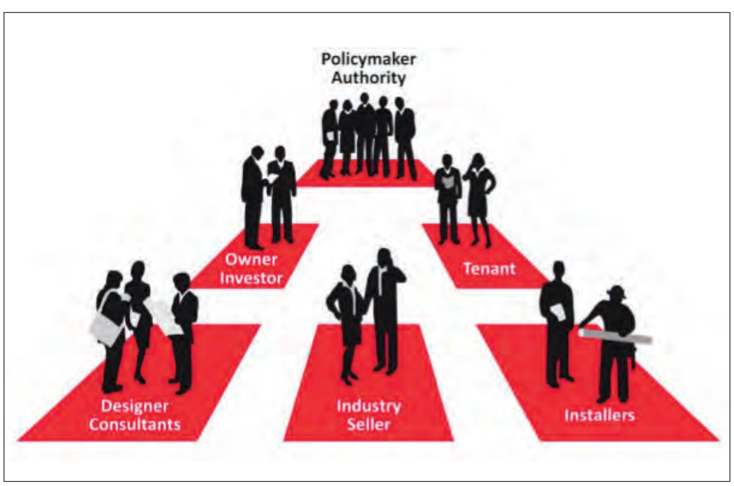
Authorities can find information on regulation and certification approaches for lighting retrofits.

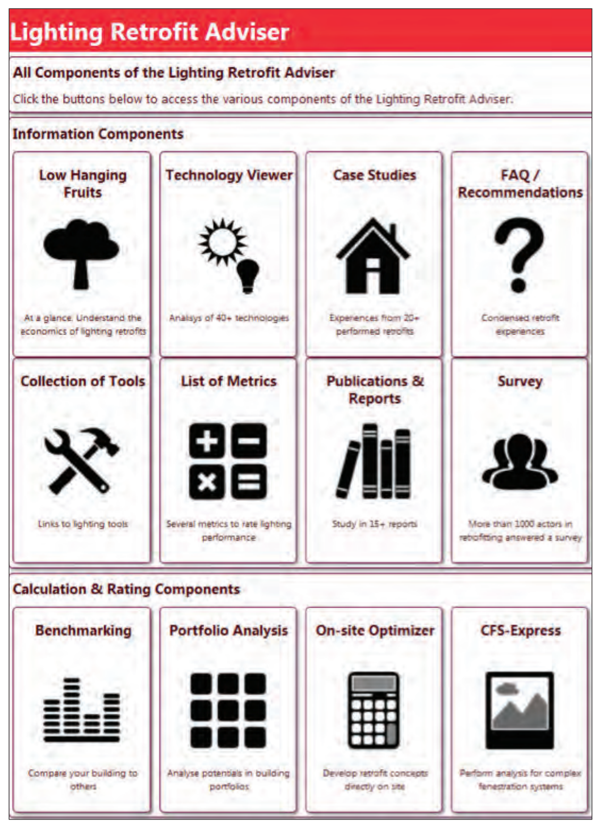
Investors can inform themselves on the economic boundary conditions of bringing new lighting systems into practice.

Designers / consultants can make use of for instance an "On-Site Optimizer" that allows to develop retrofit concepts directly on site, while drawing from a knowledge database of 40+ retrofit techniques (daylight, electric lighting and lighting controls) and 20+ case studies.

The LRA consists of two categories of components organized in an information section and a calculation & rating section. An overview on the different components is shown in Figure 1. The Information Components section presents findings in a condensed and interactive format. The Calculation & Rating Components section offers approaches to develop retrofit concepts for specific building (portfolios):

- *Benchmarking:* Compares installed power and energy consumption for lighting purposes of your building to typical values.

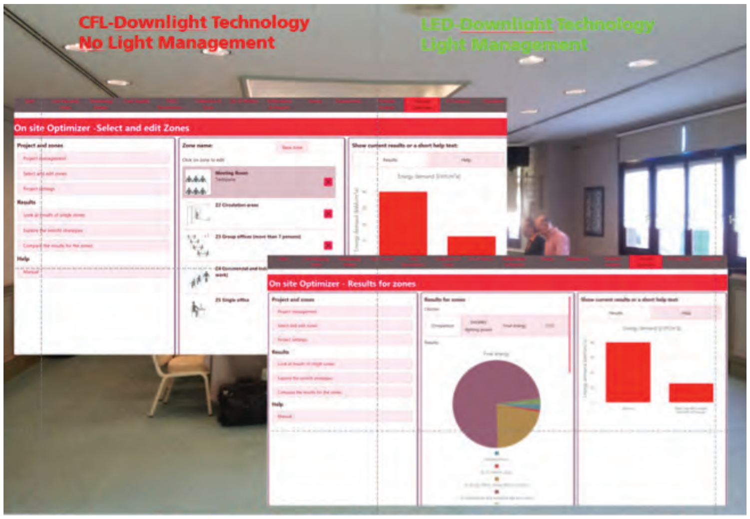




Components of the Lighting Retrofit Adviser.

continued on page 14

Lighting Retrofit Adviser *from page 13*



▲ **Figure 2. On site assessment of a meeting room at an IEA SHC Executive Committee meeting.**

- *Portfolio Analysis*: Analyzes a portfolio of several buildings and compares it to typical consumptions of comparable portfolios.
- *On-site Optimizer:* Lighting is decentralized in buildings. Often there is no detailed information available on the energy performance, operation hours, and in the end, on the economics of the lighting installations. This component (see Figure 2) allows on-site assessment for a direct analysis of potentials (energy, CO2 emissions, economics). To support further development of retrofit options, it automatically generates retrofit proposals.
- *CFS Express:* The "CFS Express" allows analysis of the impact of different complex fenestration systems (sun shading, glare protection) on natural illumination of spaces and energy demand for lighting. It delivers hourly values. Users can chose from 19 representative locations worldwide (geographic site, and climatic data).

Summer School with a Twist

The recently held summer school, "City in Transformation: Energy and the Urban Environment" brought students together with researchers and teachers in combination with the IEA SHC Task on Solar Energy in Urban Planning. Over the course of a week, students from different fields and German universities developed a master plan for solar optimized buildings in an area of Berlin's Adlershof district and then publically presented project designs.

The EnEff:Stadt (Research for an Efficient City) Summer Academy was integrated into IEA SHC Task 51: Solar Energy in Urban Planning, and funded by the German Federal Ministry for Economic affairs and Energy (BMWi). The link with this summer school is a key component of SHC Task 51 – to strengthen solar energy in urban planning education at universities by testing and developing teaching material for programs in architecture, architectural engineering and urban planning. As Maria Wall, the Operating Agent of SHC Task 51 notes, "Such summer schools and courses provide valuable input to improve teaching methods and assessment tools for solar energy planning. And the students seemed to appreciate the summer school – which makes this a win-win situation."

▼ **Figure 1. Open discussion with Students and international Experts at the Adlershof Forum.** Photo: T.Lorenz, BUW University, Urban Institute

To ensure this education objective is met,Task experts, led by Tanja Siems and Katharina Simon of the University of Wuppertal, are focusing specifically on communicating new research results and developing teaching material for tertiary education and continuing professional development education. The September EnEff:Stadt Summer Academy is one example of strengthening solar energy planning. An outcome of this work will be a catalogue of analogue and digital teaching material that include lectures as well as methodologies for seminars and interdisciplinary workshops as well as an evaluation of digital teaching approaches and the use of various software tools that are good examples for the simulation of solar assessments on the urban scale.

◀ **Figure 2. Seminars for interdisciplinary student groups with academic staff.** Photo: T.Siems, BUW University, Urban Institute.

continued on page 16

Summer School *from page 15*

Approach of the Interdisciplinary Summer School

The "City in Transformation: Energy and the Urban Environment" summer school brought together students, researchers and teachers from various disciplinary backgrounds to the halls of Hochschule für Technik und Wirtschaft (HTW), the largest University of Applied Sciences in Berlin.

The various lectures, seminars and tutorial sessions accentuated the interdisciplinary nature of the event as participants explored the topic "Energy and the urban Environment" from all applicable angles. Participants from the field of architecture, urban and energy design, and spatial and regional planning reflected on this wide variety of disciplines, which in turn resulted in stimulating discussions between the student working groups.

Berlin Adlershof was selected to serve as the "educational field experiment" to generate a sustainable approach to a master plan strategy. Berlin Adlershof as a technology park was founded in 1991 after the dissolution of the Academy of Science of the German Democratic Republic, and today covers 4.2 square kilometers making it the largest science park in Germany. The WISTA Management Ltd, which supported the summer school with experts for tutorials and talks, was founded in 1994 as the plans for a new science and technology park took shape. Since then, WISTA has helped to develop the cluster partly like a business incubator, with network management, communication and marketing, acceleration of special fields of technology, and acquisition of projects, investments and companies. Today, there is still room for extending the science park using the industrial area along the former airfield in the west and the goods station in the north. The summer school used these areas to challenge and underline the WISTA Management Ltd development plans for business and housing projects to accommodate students and families.

Methods and Tools Used During the Summer School

To have from the outset a comprehensive overview of the to-be-developed area, the students started the workshop with a guided expert tour led by the WISTA Management department. The experts explained in detail the urban planning strategy and energy related systems of the Berlin Adlershof case study. After the three hour guided tour, the students explored the site on their own as a starting point in the analytical process.

During the week, the academic staff from the different institutions gave various inputs in the form of tutorials, seminars and lectures. The designer and planning experts from the Adlershof WISTA Management group gave direct tutorial input after the student group presentations. And, every day the students documented the design and planning process in plans, models and filmic interviews to generate a documentation of the interdisciplinary decisions that were being made along the creative process.

▲ **Figure 3. Guided expert tour" with Dr. Mekiffer and Mr. Lauterbach.**
Photo: T.Siems, BUW University, Urban Institute

▲ **Figure 4. Open Discussion with Students and Experts.**
Photo: T.Lorenz, BUW University, Urban Institute

▲ **Figure 5. Case Study Berlin Adlershof: Site plan.**
Drawing: K.Simon, BUW University, Urban Institute

continued on page 17

Summer School *from page 16*

What made this summer school so unique is that students from the disciplines of architecture, urban design and planning teamed up with students of energy design and regional and spatial planning. These trans-disciplinary student working groups started with an analysis of the existing urban structure and the utilization of the area to evaluate the strengths and weaknesses of the entire district. In this way, the groups could identify the urban and energy potentials and formulate a strategy plan for the site and the selected areas A0 - A8 (see site plan in Figure 5).

▲ **Figure 6. Student´s presentation of the urban and energy concept at the Adlershof Forum.** Photo: T.Siems, BUW University, Urban Institute

Students then generated various strategies and scenarios in relation to the urban function, utilities and typologies. After the intense analyzing process to examine the volumes of the different strategies in more detail, a physical model was generated for these scenarios in relation to the urban fabric with its functions and typologies.

This physical model was used to test their structural design ideas, such as positioning different typologies of settlement as well as technical infrastructural elements and systems. In parallel with the design process, the students used the software tools District Energy Concept Adviser (DECA) to calculate the energy demand and to recognize the energy potentials and EnOB-Lernnetz to solar irradiation potential of the surfaces and demonstrate the shading problems of the buildings, which aided in the development of a sustainable energetic concept.

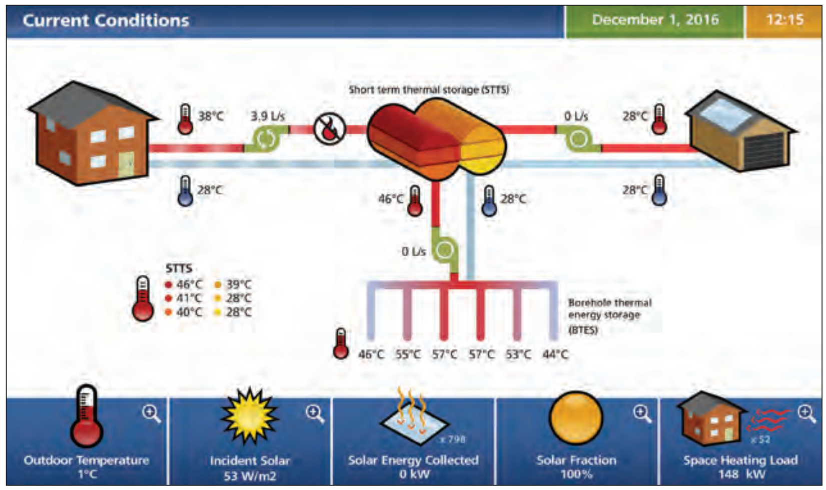
This summer school is one example of how students can gain in-depth, hands-on experience so that they can later apply their newly acquired knowledge in practice.

Adlershof is one of 32 case studies from 10 countries that will be included in the 2017 SHC Task 51 publication, *Best Practice Case Studies and Case Stories.*

This article was contributed by Prof. Dr.-Ing.Tanja Siems and Katharina Simon of the Institute for Urban Design & Studies, University of Wuppertal and experts in SHC Task 51: Solar Energy in Urban Planning in cooperation with Prof. Dr.-Ing. Susanne Rexroth HTW University of Applied Sciences Berlin and Dr. Gustav Hillmann, Margarethe Korolkow, IBUS Berlin. Clcik here to learn more about SHC Task 51.

Canadian Solar Community Hits 100% Solar Heating

The Drake Landing Solar Community in Okotoks, Alberta hit a new solar performance milestone record – 100% solar space heating for the 2015-2016 heating season. This is the first community in the world to accomplish this feat. The community of 52 energy efficient homes is heated by a solar district heating system combined with a borehole seasonal heat storage designed to store abundant solar energy underground during the sunny summer months and recover this heat for space heating during the cold winter months. This is the first system of this type designed to supply more than 90% of the space heating with solar energy and the first operating in such a cold climate (winter -38°C and summer 28.3°C).



The system was originally designed to achieve 92-93% solar space heating fraction in a typical year. System improvements over the years including lower heat delivery temperature to the homes, enhanced thermal stratification through reduced flow rates, and more efficient and timely transfer of heat from long term storage in anticipation of a cold front, have led to an improved performance. In the last five years the system has consistently exceeded original expectations with an average solar heating fraction of 96%. Whereas 100% solar fraction was originally expected to be a rare event (in fact in the original system simulations using 50 years of real weather data 100% was not achieved until year 34!) we now expect this to be a relatively common occurrence.

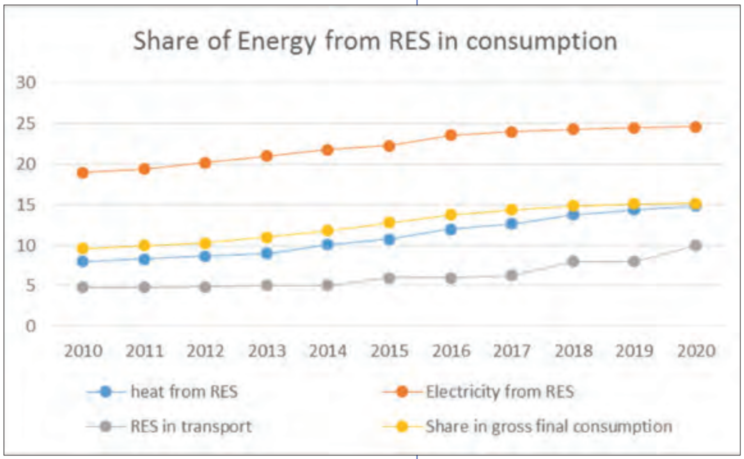
It is also noteworthy that this high solar heating performance has been achieved with very low electricity usage, with a coefficient of performance above 30. This means that for every kWh of electricity used by the pumps, the system delivers more than 30 kWh of heat, 8-10 times more efficient than heat pumps. As a result, this technology offers significant potential to minimize the impact on the electrical grid with the trend towards electrification of heating loads.

Natural Resources Canada initiated the Drake Landing Solar Community project in 2007 and remains the central coordinator for this first-of-a-kind renewable energy project. For additional information on the Drake Landing Solar Community please visit www.dlsc.ca.

Slovakia Joins IEA SHC!

IEA SHC Newest Member

IEA Solar Heating and Cooling Programme welcomes Slovakia as the first country from Eastern Europe to join the Programme. Participation by the Slovak Innovation and Energy Agency (SIEA) in the IEA SHC builds on collaboration by Slovakia in the Programme's lighting retrofit work.



Source: SIEA

As explained by Slovakia's IEA SHC Executive Committee member, Artur Bobovnický, "We'd been discussing various options with the staff at the Ministry of Economy's International Energy Affairs Department, and our efforts have resulted in the ministry's approval to finance one pilot participation in a TCP. We chose the Solar Heating and Cooling Programme because a well-respected associate professor, Stanislav Darula, from the Institute of Construction and Architecture of the Slovak Academy of Sciences, participated in SHC Task 50: Advanced Lighting Solutions for Retrofitting Buildings." Seeing the importance of this Task and other SHC Tasks for Slovakia, it proved to be a natural fit and Slovakian is now participating in Task 56: Building Integrated Solar Envelope Systems for HVAC and Lighting.

SIEA, founded in 1993 and a staff of 225, is an active partner in the growing number of national and international projects dealing with a wide range of issues from energy, renewable energy and energy efficiency to innovative approaches in technology. Bobovnický estimates project funding to reach 2.9 billion between 2014 and 2020.

Steady Growth of Renewables

National legislation doesn't set goals for the production of heat from renewable energy sources (RES) nor are there set goals that specific technologies need to achieve. Instead the country uses subsidies as the main market driver. For example, subsidies for district heating as part of the renewal of the network infrastructure are planned, including in the capital city Bratislava. Subsidies are also being used in the residential sector, which starting in 2016 is supporting RES technology up to 10 kW and covers solar heating, wind, solar PV, heat pumps and biofuel boilers.

National Subsidy Scheme Drives Market

Slovakia's subsidy scheme is the major driver behind the country's solar market growth. Green Homes, a subsidy program managed by SIEA, had its first invitation to tender in December 2015 and subsidized 1,260 renewable installations, among them solar water heaters, photovoltaics, heat pumps and small wind mills for residential homeowners as well as apartment associations. The second call in May 2016 resulted in 1,723 vouchers worth EUR 3.6 million, according to a press release from 1 July. The majority of the vouchers were for solar water heaters – 259 during the first call and 897 during the second one. The third call started in July. Only Solar Keymark certified solar collectors are eligible and installers have to be registered at SIEA.

For more information visit Slovak Innovation and Energy Agency (SIEA) at www.siea.sk or contact the IEA SHC Executive Committee member, Artur Bobovnický at artur.bobovnicky@siea.gov.sk.

"Slovakia's subsidy scheme is the major driver behind the country's solar market growth."

ARTUR BOBOVNICKÝ
Slovak Innovation and Energy Agency

Solar Thermal in Qatar Today and Tomorrow

COUNTRY HIGHLIGHT

In recent years, the population of Qatar has grown at an increased rate than was previously seen and so has carbon emissions. As the population has grown at a faster rate than previously seen and demand for resources that will result in further increases in the rate of carbon emissions. Considering the wider impacts of carbon emissions on our climate, it is vital to reduce these emissions using effective renewable solutions. In the context of building design, as investment in the built environment continues the requirement to deliver low-energy buildings will become ever more pressing as natural resources dwindle and the cost of energy fluctuates.

QATAR NATIONAL STRATEGIES

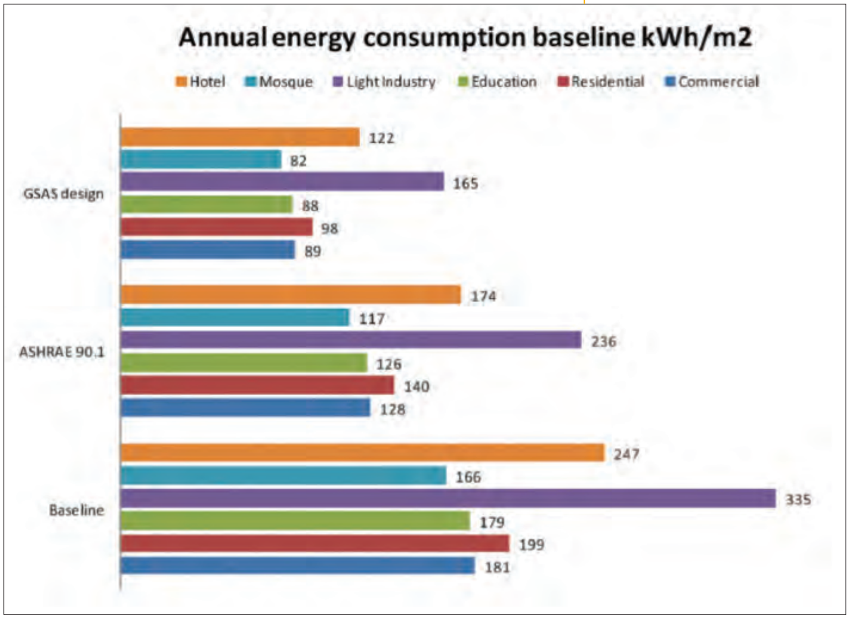
By 2030, Qatar aims to be a society capable of sustaining its development and providing a high standard of living for its people. The Qatar National Vision 2030 (QNV 2030) embraces four main pillars 1) economic, 2) social, and 3) human and 4) environmental dimensions. QNV 2030 defines the long-term outcomes that are sought for the country and provides a framework within which national strategies and implementation plans can be developed. The initial path for this vision was set out within the Qatar National Development Strategy (QNDS) 2011–2016, launched on 28 February 2011, which describes a strategy for sustainable development in Qatar and promotes energy efficiency in new buildings.

Population and Society

The total population of Qatar is expected to continue to grow steadily at an annual average rate of about 2.1%, and with such projected growth further demands for resources will compound the already high carbon emissions of the country. Considering the wider impacts of carbon emissions on our climate, and the need to reduce emissions, it is necessary to investigate and arrive at strategies for effective solutions to achieve Qatar's overall goal to reduce its carbon emissions.

Building Codes and Legislation

As a response to an overall environmental policy laid down by government initiatives as per QNV 2030, the Gulf Organisation for Research and Development (GORD) has repeatedly demonstrated its commitment to sustainability, notably by the development of the Global Sustainability Assessment System (GSAS).

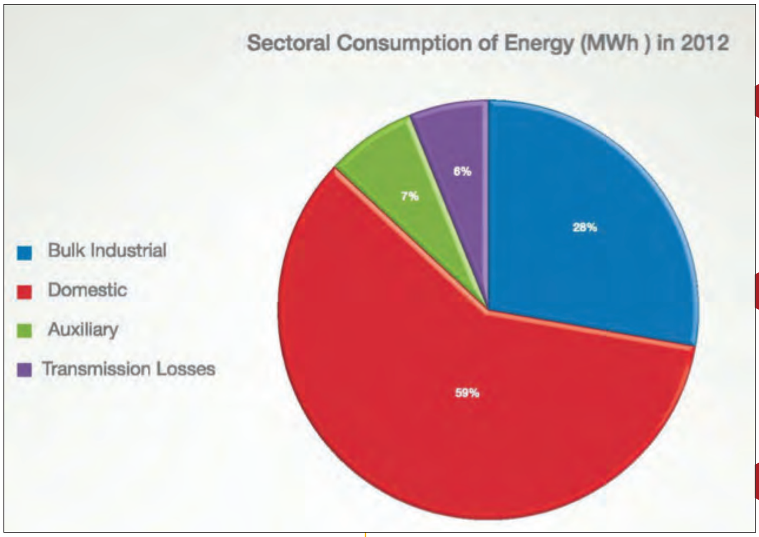


Energy Benchmarks of New Buildings

continued on page 21

Qatar *from page 20*

QNDS (2011-2016) stated, "The Qatar Sustainability Assessment System for Green Buildings will establish green building standards to which all government buildings will have to conform by 2016. Afterward, all new commercial buildings and residential buildings will be brought into the new regime."



▲ **Sectoral Energy Consumption breakdown.** Source: Statistics Report 2012, Qatar General Electricity & Water Corporation KAHRAMAA.

GSAS is an expansion of the Qatar Sustainability Assessment System (QSAS) code designed to be the first green building standard in the Middle East and North Africa based on a comprehensive review of global best practices and its adaptation to the regional context. GSAS offers various means for meeting these requirements in the design and operating stages considering building envelope, building services and human factors. Each building type, whether it is civic, commercial or residential (there are also a variety of subcategories within civic – including for example, schools, mosques, sports facilities) have an Energy Benchmark (kWh/m2/year). GSAS benchmarks are equivalent to 30% below the existing average levels of energy consumption in the building type design using current standards. Qatar Construction Specifications (QCS-2014) upgraded its requirements aimed at improving the energy efficiency of domestic and non-domestic buildings by adopting the GSAS requirement.

Carbon Emissions and Global Context

The worldwide drive towards curtailing carbon emissions and improving the sustainability of our social and economic networks is now well underway. As noted above, the technical reduction potential for Qatar is enormous because of the very high actual energy consumption and emission figures. As such, Qatar could become a world leader in disruptive change towards a low carbon economy.

In such an effort, the building sector is of paramount importance. Domestic energy consumption is about 60% of Qatar's electricity use. However, cooling accounts for 67% of all energy consumption in buildings in Qatar

A GLANCE AT SHC IN QATAR

Installations of solar hot water systems in new buildings across the country have increased dramatically in the last two years. With the average daily sunshine around 9.5 hours, low cloud cover conditions, ample rooftop space on all buildings and a Global Horizontal Irradiance [GHI] of 2,135 kWh per m2 per year, the country is well suited for solar thermal systems and positioned to tap its tremendous solar energy potential. Solar thermal energy has multiple advantages for Qatar in the form of energy security, improved air quality, reduced use of fossil fuels and CO_2 emissions.

Solar Water Heating (SWH)

The major solar thermal project in the country being executed to meet hot water demand is Msheireb Downtown, a mixed used development. The buildings have more than 1 MW of solar thermal collectors to ensure a continuous supply of hot water.

continued on page 22

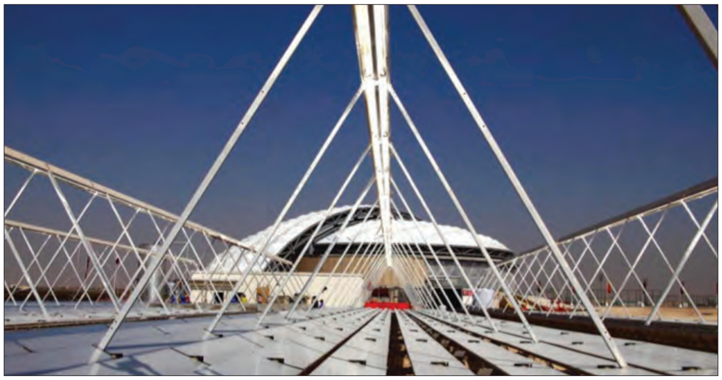
Qatar *from page 21*

Another project, ISF camp, has also installed around 1 MW of solar panels. In addition, many residential and commercial projects have installed solar water heating systems, with a capacity of 1.5 MW. It is anticipated that next year, several buildings in the new development of Lusail City will also install SWH; the anticipated capacity is over 2 MW. And, it is also estimated that over 1 MW will be installed in other projects.

Solar Cooling

One of the biggest projects that incoportaes the solar cooling concept in Qatar is the showcase stadium that was used for the bid for the World Cup 2022. It consists of Concentrated Solar Panels (CSP) for cooling the stadium. The CSP array exceeds 2,000 m2 with the height of the installation around 4.7m (including the base). The CSP system provides super hot water, around 170 degrees Celsius, directly to the vapor absorption chiller that in turn provides chilled water to the showcase stadium.

This article was contributed by Dr. Esam Elsarrag, Director of Research at the Gulf Organisation for Research and Development (GORD) and IEA SHC Executive Committee member. For more information on GORD go to www.gord.qa.



▲ **The CSP solar collector array at the showcase stadium.**

▲ **GORD's Technohub, the first novel technology-based platform for research and cutting-edge technologies in the MENA region, aims to assess, develop and promote affordable, clean and efficient solutions. The Technohub consists of a 17.6kW absorption chiller and 25kW desiccant cooling systems driven by a 40kW solar thermal system.**

Industry and Research Join Forces on Reliability Testing of Collectors and Materials

*Speed*Coll

Solar thermal collectors and their components are commonly exposed to a wide range of climatic influences. Next to UV radiation, factors like humidity, wind, extremely high or low temperatures, salt, sand and other particles in the atmosphere affect the surfaces and performance of these products. Although these influences are decisive factors for the lifetime and long-term efficiency of solar thermal collectors, there are no validated or binding test procedures for reliability assessment over time or models that allow a location-specific service life prediction. The projects *Speed*Coll (2011-2015) and *Speed*Coll2 (2016-2020), funded by the German Federal Ministry for Economic Affairs and Energy / Project Management Jülich and the support of many leading industry partners, have started to fill these gaps by being the first initiatives to assess the durability of solar thermal collectors and their components with a global outdoor exposition campaign. This work is supported by the valuable input on quality assurance, reliability testing and also standardization and cost reduction efforts from projects of the IEA SHC, specifically Task 43: Solar Rating and Certification Procedures, Task 54: Price Reduction of Solar Thermal Systems and Task 57: Solar Standards and Certification.

▲ **Exposed solar thermal collectors in the Negev desert, Israel.**

Outdoor Exposure in Global Hot Spots

In the project *Speed*Coll, solar thermal collectors and samples of their components (glass, reflectors, absorbers, adhesives) were exposed at different outdoor exposition sites around the world. Each test stand was characterized by extreme climatic conditions and distinctive combinations of stress factors and monitored for more than three years. Starting with two reference test stands with moderate climatic conditions in Freiburg and Stuttgart, Germany, samples were exposed to four other climates 1) the island of Gran Canaria, a maritime climate with high UV loads and corrosive atmosphere, 2) the Negev desert in Israel, an arid climate with high temperature variations, soiling and sand loads, 3) the Zugspitze in the German Alps, an alpine climate with high irradiation and UV, and 4) in Kochi, India, a tropical climate characterized by high moisture loads and temperatures.

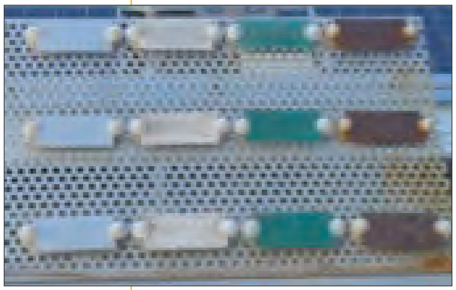
▲ **View from the alpine exposition test stand on the Zugspitze in the German Alps.**

Scientists from the Fraunhofer Institute for Solar Energy Systems ISE (coordination) and the Institute of Thermodynamics and Thermal Engineering (ITW) / Research and Test Centre for Solar Thermal Systems (TZS) of the University of Stuttgart measured the temperature, UV concentration, humidity, wind load, atmospheric corrosivity and irradiation at the sites and also monitored the resulting microclimate (i.e., the specific conditions in the flat plate collectors themselves). The measurements yielded valuable results, some of them not expected before the start of the project. "What astonished us," *Speed*Coll's project leader, Dr. Karl-Anders Weiss explains, "was the fact the highest absorber temperatures were in fact measured on the Zugspitze in the German Alps, the only test stand with snow loads for several months of the year." On Gran Canaria, on the other hand, insights were provided concerning other phenomena. At the test stand located about 100 meters next to the sea, salt aerosols in the atmosphere caused the highest corrosion rates measured in a global corrosion campaign. While corrosion was partly visible at the outside of the collectors their inside was nearly free of any influence. This shows the generally good quality of the collectors. How the

continued on page 24

Reliability Testing *from page 23*

climate would affect them beyond the three years is the crucial question and part of the follow-up project *Speed*Coll2.



▲ **Corrosion coupons as part of a global corrosivity campaign on Gran Canaria, Spain.**

On the Way to Standardized Durability Tests

For a future estimation of such long-term effects, the data was translated to accelerated aging tests where they were pushed to an extreme. "The most challenging part in defining aging tests is to find the right acceleration factor for each component to simulate aging without destroying the material too quickly", Weiss continues, "in *Speed*Coll, we worked with experienced researchers who carefully reviewed our outdoor exposition data and combined them to test routines for the factors UV, high temperatures and corrosion as groundwork for globally accepted standards for durability testing."

The possibility to introduce *Speed*Coll's test cycles to international standardization committees was given by a strong engagement of the project in relevant solar thermal standardization committees, such as the Solar Keymark Network, DIN, CEN, ISO and SHC Task 43: Solar Rating & Certification where the researchers are active members. As such, they were the perfect delegates to present the project and help it to international recognition. "*Speed*Coll is a good example for successful research and the parallel transfer and exploitation in the SHC framework," the project's supervisor at PTJ and member of the Executive Committee Dr. Peter Donat confirms. "SHC Tasks are the vehicles for bringing research results to the place where they have the biggest impact. This can be on a political level, in further research cooperation, or, as shown here, in standardization efforts."

Life Time Estimation and Cost Reduction Potential

As a continuation of the exchange on durability testing, the project's follow up is also strongly tied to the SHC Programme. *Speed*Coll2 supplements the work started in the previous project by developing numerical models that allow lifetime estimation for the tested samples. These will be directly brought in to SHC Task 57: Solar Standards and Certification and form part of SHC Task 54: Price Reduction of Solar Thermal Systems, where the economic potential of the project is the center of attention. A binding method for life time assessment of solar thermal collectors will allow a location specific and cost-effective manufacturing of tailored products, which will be crucial for reducing total costs of the solar thermal systems.

▲ **Tropical test stand in Kochi, India with solar thermal collectors and components.**

About the Projects

The *Speed*Coll "Development of Accelerated Aging Tests for Solar Thermal Collectors and Their Components" (2011-2015) was implemented by the Fraunhofer Institute for Solar Energy Systems ISE (Coordination) and the Institute of Thermodynamics and Thermal Engineering (ITW)/ Research and Test Centre for Solar Thermal Systems (TZS) of the University of Stuttgart with funding of the Federal Ministry for Economic Affairs and Energy / Project Management Jülich (Fkz.: 0325969) and the support of 15 industry partners. The developed test cycles and data entered several SHC Tasks as valuable groundwork for technological and economic research questions. (www.speedcoll.de)

*Speed*Coll2 "Durability Estimation of Solar Thermal Collectors and their Components" started in August 2016 and will run for four years. It is continuing the work started in *Speed*Coll by translating the results of the outdoor exposition and indoor testing cycles to numerical models for lifetime estimations. *Speed*Coll2 is strongly supported by the German Federal Ministry for Economic Affairs and Energy / Project Management Jülich (Fkz.: 0325865) and the support of 13 industry partners.

This article was contributed by Sandrin Saile, Fraunhofer ISE, Sandrin.saile@ise.fraunhofer.de and Karl-Anders Weiss, Fraunhofer ISE, karl-anders.weiss@ise.fraunhofer.de

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 58 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.

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SOLARUPDATE

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