SOLARUPDATE
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Newsletter of the International Energy Agency Solar Heating and Cooling Programme

Turkey to Host SHC 2015

SHC 2014, the International Conference on Solar Heating and Cooling for Buildings and Industry, was held in Beijing, China this past October.

In 2015, the conference will move from the largest solar thermal market worldwide to a country with a very active and dynamic solar thermal market, currently the biggest in Europe – Turkey, the newest IEA SHC country member. SHC 2015 will take place from December 2-4, 2015 in Istanbul.

Abstracts due – July 6
Registration online begins – August 22
Early Bird registration ends – September 22

This year IEA SHC is partnering with ESTIF, the European Solar Thermal Industry Federation, and GÜNDER, the Turkey Section of the International Solar Energy Society. As in previous years, the conference will be organized by PSE. Over 300 participants from science, organizations and companies around the world are expected to attend the conference.

On an Industry Day, international industry leaders will address issues such as competitiveness, new markets and market deployment, products and future trends. This day will bring together researchers, industry and other important stakeholders in the sector. Researchers will cover many topics including the latest technology developments, integration of solar technologies into urban environments and energy systems, solar resource measurement and energy storage.

Companies are invited to attend as sponsors or exhibitors to take advantage of the tremendous opportunity to meet key players in both the solar market and research fields and to get in touch with leaders in the solar thermal sector worldwide, and especially in this region called the "solar band." To learn how you can become a sponsor visit the SHC 2015 website.

Don't miss SHC 2015, the dynamic and informative platform for the exchange of expertise and knowledge! Reserve the date on your calendar right now!

For the latest conference information go to www.shc2015.org.

I am sure that you and the other SHC 2015 participants will be inspired by the conference sessions and discussions as well as by the developments in Turkey and that you will go away ready to help deploy solar thermal technologies.

KEN GUTHRIE
IEA SHC Chair

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In This Issue

NEWEST MEMBER

TURKEY
Solar Era Is Just Beginning

In parallel with its population and GDP growth, Turkey has been experiencing rapid demand growth in all segments of the energy sector for decades. Turkey is developing an integrated energy policy aimed at securing a reliable supply of energy, as well as achieving a low-carbon and environmentally sustainable future. Turkey also intends to promote employment and economic growth through its energy development. Solar energy plays a major role in Turkey's renewable energy roadmap due to the fact that is geographically located the "solar band" region.

With a population reaching 76.7 million[1], Turkey's energy consumption based on primary energy resources is continuing to increase and this is compounded by the rapidly growing economy. Turkey's increasing energy demand is mostly met by fossil fuels, of which a large portion is imported. The total installed capacity of power is 69,516 MW and the breakdown by resource is 59.7% fossil fuels (natural gas, coal, liquid fuel, etc.), 34% hydro, 5.2% wind and 1.1% other renewables[2]. Turkey pays millions of dollars for its energy imports every year. In addition to this, the number of buildings has reached 9.3 million and the number of residential and commercial units in these buildings reached to 22 million in 2014, which consume 28.2 million tons of oil equivalent (TOE), mainly natural gas, coal and wood for heating and electricity for cooling.

Energy security and a sustainable energy supply are among the main policy concerns of Turkey. Significant importance is placed on:

- Encouraging energy production from renewable sources in a secure, economic and cost effective manner,
- Expanding utilization of promising renewable resources,
- Increasing diversification of energy resources,
- Taking significant steps to increase energy efficiency,
- Reducing greenhouse gas emissions,
- Making use of waste products and protecting the environment, and

continued on page 3

[1] "The Results of Address Based Population Registration System, 2013". Turkish Statistical Institute, Released in 2014.

[2] "5-year Electricity Energy Production Capacity Projection of Turkey (2014-2018)", Published by TEIAS (Turkish Electricity Transmission Company), June 2014. www.teias.gov.tr

▼ This multifamily housing project was built after the 2011 earthquake disaster in Van. Solar is used to provide hot water to the residents.

Turkey *from page 2*

- Developing related mechanical and/or electro-mechanical manufacturing sector.

▲ **Solar thermal application for hot water production at the Ephesia Hotel in Kusadasi on the Agean coast.**

Reasons to support renewables in Turkey are to secure the energy supply using domestic sources, to lower import dependency (less than 28% of total produced locally, 32.3 million TOE), to manage the current account deficit (energy imports reached to 60 billion USD which is 25.3% of total imports) and to meet the energy target renewables' share is to be 61,600 MW by 2023.

Solar energy has the potential to greatly reduce this cost in the medium and long term with a feasible potential of a minimum of 450 GW. In the face of increasing oil prices and the need for national energy security, it is widely recognized that it is imperative for Turkey to increase the contribution of renewable energy resources rapidly. Solar energy is the most important alternative clean energy resource that is still untapped in Turkey. The yearly average solar radiation is 1,311 kWh/m^2 per year and 3.6 kWh/m^2 per day. The total yearly solar radiation period is approximately 2,460 hours per year and 7.2 hours per day.

Industry Development and the Importance of the IEA SHC Programme

Turkey currently has the biggest European solar thermal energy market. And worldwide, Turkey is ranked fourth in cumulated installed capacity and ranked second in newly installed capacity. The country's solar industry, with more than 90 manufacturers and 3,000 installers, is increasing its activities and supplying 1.5 million m^2 of locally produced solar thermal collectors annually. Domestic hot water is still the main usage area rather than solar heating and cooling, which are almost negligible at this stage although the market promises great opportunities.

Financial policies and supporting mechanisms, new laws and regulations, research and technology policies, and dissemination of knowledge, education and training targeting Solar Heating Cooling are the needs and the experiences to be learned from experienced countries. Turkey's participation in the IEA SHC Programme will not only speed up this transition period, but also add efficiency to Turkey's efforts. As Turkey's HVAC/R export is more than 4 billion USD and is strengthening its position in global HVAC/R trade with increasing quality and reputation, Turkey's cooperation with IEA SHC members will be beneficiary to all parties in all dimensions, especially for technology development and shaping the solar future.

GÜNDER

International Solar Energy Society Turkey Section

The solar energy market is accelerating and development is occurring in all areas from production to installation with the support of raising awareness in all sectors of society. The Turkish solar energy associations continued their endeavors to facilitate information flow for a healthy market development. One of the events organized by GÜNDER entitled "SOLARTR 2014 Conference and Exhibition" held in Izmir on November 19-21, 2014, included trainings, meetings and workshops on capacity building and the removal of barriers. The conference was organized with the participation of the leading organizations in the solar energy industry from researchers to industry representatives and from the

continued on page 4

Task 50
Bypassing Barriers to Lighting Retrofit: Is Solid State Lighting Already Changing the Game?

In comparison with a lighting solution using fluorescent sources, Solid State Lighting (LED) comes with different technical, operational (maintenance) and economical parameters. Work within IEA SHC Task 50: Advanced Lighting Solutions for Retrofitting Buildings *studied the impact of these fast changing parameters on lighting retrofits – intending to give sound advice to decision makers.*

A large fraction of existing lighting installations is more than 10 years old, and often there is no plan to retrofit them before the end of life or for a major refurbishment of the indoor environment (ceilings, floors and wall finishes). Experts in IEA SHC Task 50 working in Subtask A: Market and Policies have investigated possible opportunities for lighting retrofits to benefit, as early as possible, from new and highly energy efficient lighting installations.

continued on page 5

The good news is that with the reduction in LED costs, Solid State Lighting options become more and more attractive as there is not only a possible gain in energy efficiency by improved system efficiency, but also a possibility to reduce maintenance.

MARC FONTOYNONT
Aalborg University, Denmark

Turkey *from page 3*

public to contractors. All these stakeholders came together to evaluate solar energy and the development of the industry. You can read and download the conference papers from www.solartr.org.tr

Now Turkey's solar industry is looking forward to inviting solar colleagues to the SHC 2015 Conference in Istanbul on December 2-4, 2015.

Turkey & IEA SHC

Turkey's immediate contribution to the IEA SHC is actively participating in the following projects, with the reasons briefly explained:

Task 53: New Generation Solar Cooling and Heating Systems (PV or Solar Thermally Driven Systems).
Many parts of Turkey are cooling-dominated, where global solar irradiation intensity on horizontal plane (GHI) varies between 1,600-1,800 kWh/m^2. These locations also have quiet high direct normal irradiation intensity, reaching 2,200 kWh/m^2. Under these conditions, Turkey is a very attractive test-bed and market for both PV driven small-scale solar air-conditioning and solar thermally driven medium/large scale absorption cooling systems.

Task 52: Solar Energy and Energy Economics in Urban Environments.
Turkey's urban population is experiencing remarkably increases, due to births in and migration to metropolitan areas. In addition, Turkey recently imposed a large-scale urban transformation law to reconstruct millions of homes, which are not earthquake resistant. This transformation law is leading to the construction of more energy efficient and stronger buildings. Solar energy applications for the central heating and cooling of these building complexes are highly desirable, if the lifetime costs are competitive.

Areas for Future Collaboration

Turkey hopes in the near future to initiate work on:

- Solar Refrigeration and Cold Storage for Foods
- Fully solar powered passive house strategies for Mediterranean climates
- Solar Energy for Rural Development and Employment
- Easy and Innovative Solar Energy Solutions for Rural Regions

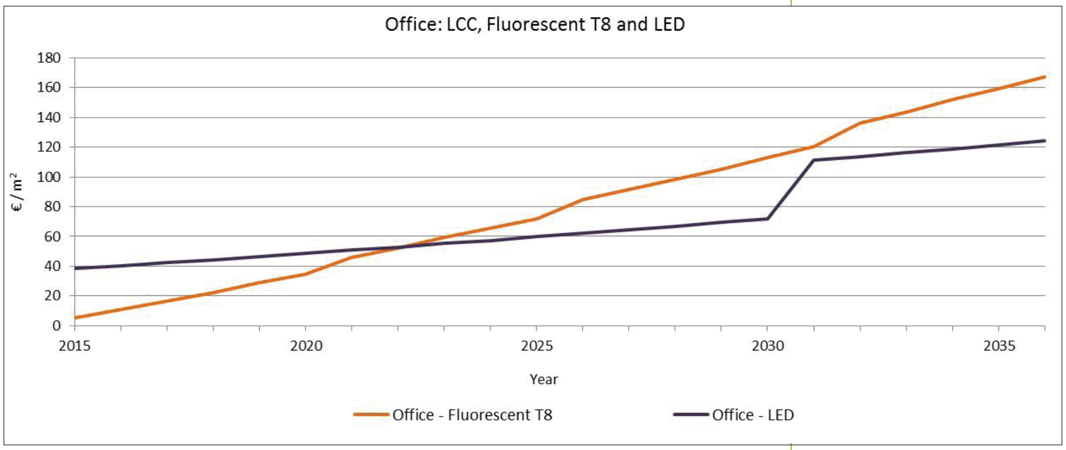
This article was contributed by Dr. Bulent Yesilata, Turkish representative on the SHC Executive Committee and Board Member of GÜNDER and Dr. Kemal Gani Bayraktar, Turkish representative on the SHC Executive Committee and President of GÜNDER. For more information on Turkey and its solar activities email info@gunder.org.tr.

Lighting *from page 4*

There are some "low hanging fruits," which are existing installations with poor efficiency and no plan for retrofit in the short term. In some cases, the return on investment is under 2 years when counting only the benefits on electricity consumption. However, in many cases, the return on investment is in the range of 3-6 years, which is usually considered too long to motivate investors. Information from stakeholders was gathered to identify on which terms and under which conditions they would be interested in accelerating retrofitting operations.

These stakeholders are: owners, tenants, facility managers, contractors (and installers), local authorities, industry sellers, design consultants, users, broker agencies, financial groups, and energy service companies (ESCOs). Some of these stakeholders are interested in:

- low investment costs,
- reduction of installation time,
- reduction of maintenance,
- extended guarantees on products,
- reduction of electricity use,
- optimization of product life, or
- opportunities for radical change of appearance of the space.



▲ **Figure 1. Evolution of cumulated costs over time, for classical fluorescent installation and new LED product.**

We see that a gain on energy efficiency is only one parameter among others. The good news is that with the reduction in LED costs, Solid State Lighting options become more and more attractive as there is not only a possible gain in energy efficiency by improved system efficiency, but also a possibility to reduce maintenance.

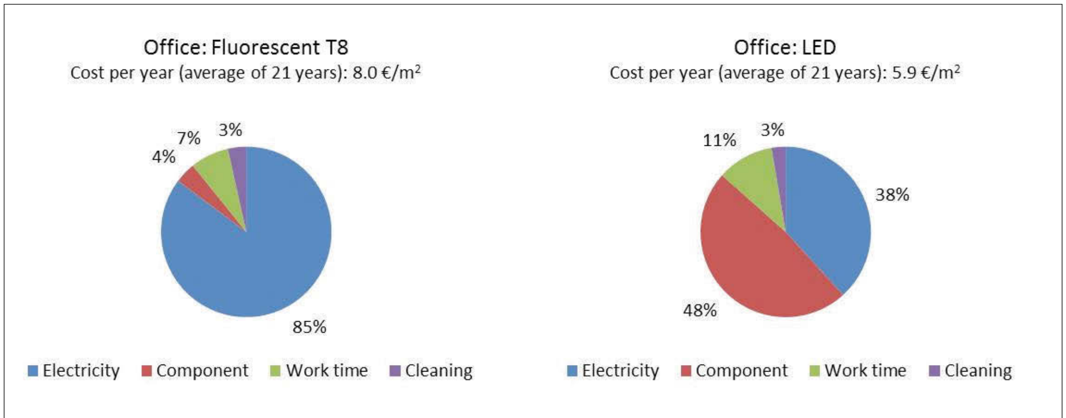
Life Cycle Cost Approach: Shifting Cost Shares

Assessing Life Cycle Costs (LCC) of lighting installations shows that the share of costs due to electricity is typically half of the total LCC value (in areas where costs of electricity are rather high, above 0.15/KWh). Investment is more than a quarter of the total cost, and installation less than half the investment (see Figure 1). The LCC is therefore very sensitive to the evolution of electricity costs. In the next 10 years, it is anticipated that the combination of increases in energy efficiency and reduction of equipment costs will stabilize these costs, but major gains will be achieved in the reduction of maintenance.

Figure 2 shows the comparison of the evolution of cumulated costs in €/m² of a classical fluorescent installation and a LED installation. Benefits in costs due to improved energy efficiency lead to a reduction of the general slope. LED based lighting does not require changing the light sources every 15,000 hours as is the case with fluorescent sources. But the whole luminaire has to be changed after 40,000 hours. It is expected that the reinvestment in LED-based lighting at the end of life will in fact be lower due to a significant cost reduction of this technology over the next 15 years. The graph shows that the operation of LED lighting requires no maintenance over the life of the products, except cleaning. However, to obtain significant benefits, it is important that the initial costs of SSL are not much higher than that of fluorescent systems.

continued on page 6

Low hanging fruits

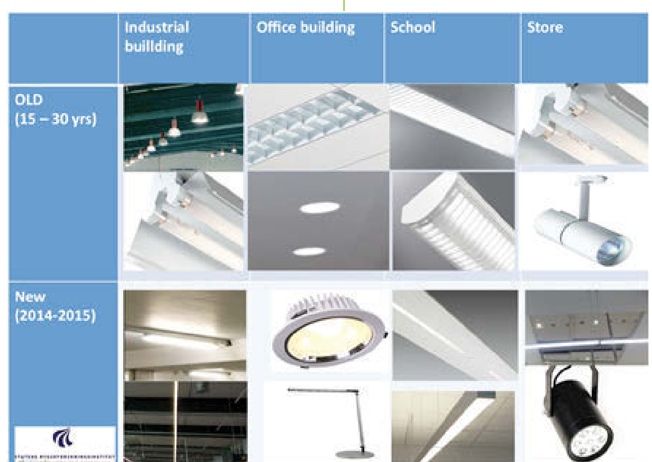


▲ **Figure 2. Life Cycle Costs of an office lighting installation using fluorescent tubes [€/m²].**

It was found that the return on investment is easier and faster on installations with high annual operating times, for example in factories where lights are on a large fraction of the time (more than 5,000 hrs/yr). Here, fluorescent tubes must be changed every two years, and SSL every 5 years. Furthermore, in factories with dirty environments it is suggested to replace equipment every 10-15 years, which is in line with the life span of SSL products.

To the contrary, in buildings such as schools, light is used more often for shorter periods, typically summing up to around 1,000 hrs/yr, suggesting that fluorescent tubes should be changed every 15 years, and SSL every 40 years. Here, the retrofit should clearly focus on possible savings in simplification of maintenance and improvement of lighting quality.

To account for differences as those explained above, typical approaches for four main building categories were investigated: industrial buildings, office buildings, school buildings and department stores. In Figure 3 typical old and new lighting systems are compared.



▲ **Figure 3. Typical existing 'old' electric lighting products found in existing buildings and highly ef-ficient 'new' lighting products, mostly using LED technology.**

Lighting retrofit and replacement of other building equipment

Development of cost models demonstrates that accelerating retrofit operations makes sense mainly for low hanging fruits; "accelerating" meaning to conduct retrofit earlier than at the end of product's life. However, often it is wise to wait for a major general retrofit (ceiling replacement, painting) since it could benefit from a possible upgrade in the electrical architecture. Hence the importance during field assessment is to identify possible times for a general retrofit of indoor spaces. Lighting, as any other technical equipment (heating, ventilation, plumbing, etc.) has its own life. But, the evolution of products and reduction of prices should lead to higher replacement rates.

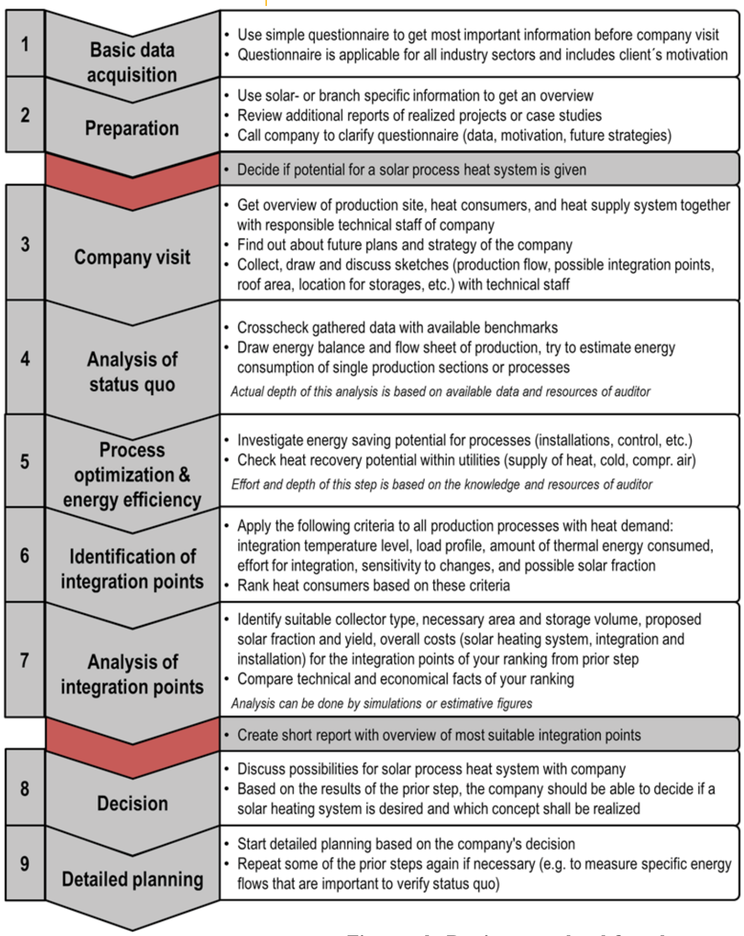
This article was contributed by Marc Fontoynont of Aalborg University in Denmark and leader of IEA SHC Task 50 Subtask A: Market and Policies.

Guidelines Developed for Process Heat Integration

Solar planners, energy consultants and process engineers now have access to a general procedure to identify and rank suitable integration points and solar thermal system concepts when integrating solar heat into industrial processes. The guidelines were developed within SHC Task 49: Solar Heat Integration in Industrial Processes.

Integrating solar heat is possible at several points in the heat supply and distribution network of an industrial production site. Basically, integration points are on the supply level (including all processes for the production and distribution of heat) and the process level (including all operations performed on the process level, including the transfer of heat to basic operations). Due to the complexity of the industrial thermal energy system and the variety of integration possibilities, a methodology was defined for the best possible approach when integrating solar process heat systems in industrial processes. This methodology builds upon existing methods and experiences of various projects and *IEA SHC Task 33: Solar Heat for Industrial Processes.*

In Figure 1 the steps of the Assessment Methodology for Solar Heat Integration are shown. The purpose of the pre-feasibility assessment is to quickly find out if solar heat can be used in a company. Based on a few key data (temperature level of consumed process heat, the available roof or ground areas for solar heating systems, the production times, and the investment policy of the company) a decision can be made to use or not to use solar heat. The feasibility study (Steps 3-7) includes a company site visit to obtain an overview of the production site, heat consumers and heat supply as well as future plans and the strategy of the company. At this point, it is useful to collect, draw and discuss sketches (production flow, possible integration points, roof areas, location for storage, etc.) with the technical staff of the company. Based on the collected information and the relevant data provided by the company, the status quo can be analyzed by comparing the collected data with the available benchmarks and by calculating energy balances and flow charts of the production processes. In this step an attempt will be made to estimate the energy consumption of the individual production or processes. The actual depth of this analysis is based on the available data and resources of the internal auditor. (Schmitt, 2015a).



▲ **Figure 1: Rating method for the integration of solar process heat** (Schmitt, 2015a).

The three step process – optimization & energy efficiency, identification of integration points and analysis of integration points are described in detail in the *Integration Guidelines*. In order to achieve an efficient integration of the solar thermal plant in industrial processes, the analysis of the measure of process integration (process optimization, heat recovery) is decisive (Krummenacher und Muster, 2015). Process

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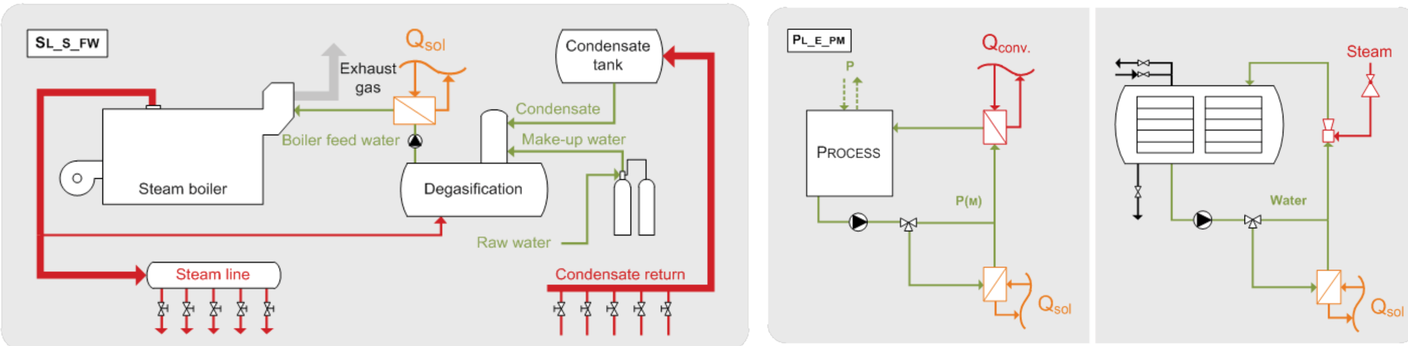

▲ **Figure 2: On the left, Solar Heat Integration Concepts for boiler feed water preheating (SL_S_FW). On the right, integration concept to provide solar heat for processes with an external heat exchanger (PL_E_PM) – general integration flow sheet (middle) and example sterilization process in an autoclave (right).**

integration provides methodological approaches to the analysis of heat recovery and identification of integration points for a new heat supply. The pinch analysis is a powerful tool to identify promising integration points on the supply and process levels. A crucial point for good planning is the combined simulation of heat recovery and solar installation.

Process integration helps the planner to identify possible integration points for solar process heat. As a next step, a suitable *Solar Heat Integration Concept* must be selected for each of the possible integration points. This Solar Heat Integration Concept shows by which heat exchanger and hydraulic connection solar heat can be transferred to a process based on the existing heat supply technology.

To ensure the fast identification of a suitable integration concept, the *Integration Guideline* presents a classification of Solar Heat Integration Concepts, including the characteristics of individual concepts (Schmitt, 2015b; Schmitt, 2014; see examples in Figure 2).

The Solar Heat Integration Concept can be extended to *Solar Process Heat System Concepts - SHIP system concepts*. These SHIP system concepts describe the whole technical concept of the solar thermal process heating system. All components of the solar thermal installation (collector loop, charging, storage if required, discharging, etc.,) are now, in addition to the integration point, specified and classified. The *Integration Guideline* shows which solar thermal installations can be linked with which Solar Heat Integration Concepts (Helmke and Hess, 2015).

On large industrial sites, several integration points and corresponding Solar Heat Integration Concepts might seem promising. The ranking methodology in the *Integration Guideline*, gives recommendations on how to evaluate the most promising candidates of Solar Heat Integration Concepts before starting detailed techno-economic analyses (Hassine, 2015).

Schmitt B., Assessment Methodology for Solar Heat Integration, In: Muster, B. (Ed.): Integration Guideline, IEA SHC Task 49, 2015.

Krummenacher P. and Muster B., Process Integration for Solar Process Heat Projects, In: Muster, B. (Ed.): Integration Guideline, IEA SHC Task 49, 2015.

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Helmke A. and Heß S., Classification of Solar Process Heat System Concepts, In: Muster, B. (Ed.): Integration Guideline, IEA SHC Task 49, 2015.

Ben-Hassine I., Identification of Suitable Integration Points, In: Muster, B. (Ed.): Integration Guideline, IEA SHC Task 49, 2015.

Non-Residential Building Renovation – The Potential, Opportunities and Barriers

A 50 - 90% reduction in heat consumption and a 50 - 70% reduction in overall energy demand are possible when renovating a building. Twenty exemplary renovation projects highlighted in SHC Task 47: Solar Renovation of Non-residential demonstrate how this can be achieved. Two buildings of these buildings achieved the plus-energy standard and one of them received the highest possible BREEAM score of "Outstanding." And, all these buildings used commercially available products and systems.

▲ The Powerhouse Kjørbo in Sandvika, Norway (the office building of the SHC Task 47 Operating Agent, Fritjof Salvesen) received a BREEAM "Outstanding – As Built" certification. Two office buildings from the early 1980s were renovated using high insulation standard, PV and a ground coupled heat pump.

Many studies show that buildings account for about 40% of the total energy consumption in OECD countries. Add to this fact that more than 50% of the existing building stock will still be in use in 2050 and that more than 50% of the buildings in many OECD countries were built before 1970. Recognizing these statistics, in April 2009 the EU Parliament approved a recommendation that member states set intermediate goals for existing buildings as a fixed minimum percentage of buildings to be net zero energy by 2015 and 2020. What does all this mean? That the potential is high and opportunities numerous for renovations that achieve a 50 - 90% reduction in heat consumption and a 50 - 70% reduction in the overall energy demand in the building.

Several of these exemplary renovation projects demonstrate that the total primary energy consumption can be drastically reduced and the indoor climate greatly improved. Because most property owners are not even aware that such savings are possible, they set energy targets that are too conservative, which then leads to buildings being renovated to mediocre performance standards and thus create a lost opportunity for decades.

The experts in SHC Task 47 analyzed highly successful renovation projects by focusing on the development of innovative concepts for the most important market segments. The Task narrowed its scope by working with mainly two types of non-residential buildings – offices and education buildings, including protected and historic buildings.

The primary indicator identified in all the successful renovation projects was a multidisciplinary, highly skilled group working towards a common goal. This group includes the building owner, the architect, consulting engineers as well as builders and contractors.

Key Findings

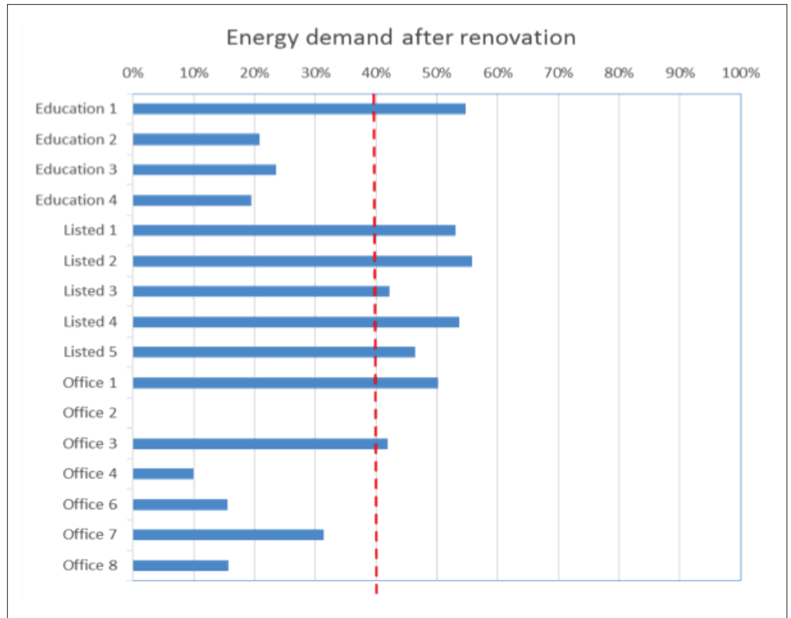
Findings from the 20 projects analyzed included:

- PV seemed to be more interesting for the building owner than solar thermal installations. One obvious reason was that most buildings are offices with limited domestic hot water

continued on page 10

and heat demand. One exception was a monastery that installed a 360 m^2 building integrated solar system to cover 20% of the space and water heating.

- It is not possible to make a significant relation between energy savings and renovation costs. However, for many projects with cost information available, costs for energy saving measures were between 70 and 210/m^2. The energy savings in these buildings varied from 45-60%.
- The total renovation cost for the two plus-energy buildings were quite similar, respectively 2,600 and 2,700/m^2. Both buildings added large PV installations.
- Windows, in most cases, were upgraded to a U-value of 1.0 W/m^2C or less, and often down to the passive house standard 0.7 W/m^2C.
- Many buildings were equipped with demand controlled mechanical ventilation systems with heat recovery, often in combination with controlled natural ventilation systems for summer months.
- Limited mechanical cooling was needed as the cooling demand is mostly covered by nighttime ventilation.
- Many buildings installed efficient lamps with daylight control and/or movement sensors.
- Pupils in one school project showed significant improvement in concentration test scores and health and well-being questionnaires after the upgrade of the ventilation system.



▲ **Figure 2. Percentage of energy demand after renovation for different building types. The red line represents the SHC Task 47 targets.**

Technology Status

A number of relevant energy efficiency products and systems exist on the market. It seems, however, that some countries, such as Austria and Germany, have a better developed commercial market than many other countries.

There is a need for optimized heating delivery systems for retrofit projects. The reason for this is that it is hard to find products that are adapted and optimized for buildings with very limited heat demand. Usually, the heating demand in retrofitted buildings can be supplied with supply water temperatures in the range of 30-40°C. And, this often requires the use of radiant heating systems, such as wall, floor or ceiling heating systems, which are operated with significantly reduced supply water temperatures. However, the installation of radiant heating systems is not always possible or is difficult to do because of the room height and available installation area.

For some buildings, it is not possible to reduce the energy demand as much as wanted due to restrictions or difficulties with the building envelope. To make the climate footprint of these buildings better, increased use of renewable energy may be a favorable option.

For historic and protected buildings, many regular energy saving measures are not compatible with preserving the old buildings character. Listed protected buildings often have requirements to keep the expression and architecture of the building, in some cases a change of the building's architecture expression is not legally possible.

Source: Claudia Dankl, AEE INTEC

▲ **Before and after photos of a school renovation in Schwanenstadt, Austria.**

continued on page 11

AUTHORITIES	Strengthen drivers	Eliminate barriers
Increase attractiveness	• As part of information campaigns use relevant media and conferences to show good examples. • Place particular spotlight on the enthusiasts (both within owner organization and advisors). • Actors receiving grants also see this as confirmation of a good decision and see this strengthening the organization's image.	• Develop convincing arguments for nZEB. • Endorse serious frontrunners. • In some countries it is obligatory that companies have a statement about their impact on the environment. This could be extended by an obligation to state what energy labels their buildings hold. This increases the awareness of the issue of the energy efficiency of buildings.
Increase competitiveness	• Increased tax on energy. • Energy labelling systems provide a neutral reference for comparing buildings on energy performance and thereby increase the focus on this as a competitive advantage.	• Put in place training programs for all relevant crafts to be updated on nZEB upgrading. • Announce stepwise enforcement of building codes.
Make it more affordable	• Stronger subventions programs for owners upgrading towards nZEB (driver in some projects).	• Stronger subventions programs for owners upgrading towards nZEB standard (barrier in other projects).
Make it more available	• Make sure the top management of building owner companies see the benefits of nZEB upgrading and as a consequence they will be more open for such initiatives within their own projects.	• When public bodies upgrade their own buildings, nZEB ambition should be required. In this way both experience and good examples are developed locally. Tender processes must be defined adequately to avoid pure focus on price. A partnering contact for the design phase seems to be a good solution for this. • Facilitate arenas for the industry to meet with researchers and other companies to share experiences.

▲ **Table 1: How authorities can contribute to increasing the number of nZEB retrofitting projects.**

INDUSTRY	Strengthen drivers	Eliminate barriers
Increase attractiveness	• Identify the owner segments which focus on sustainability. • Use relevant media and conferences to show good examples. • Place spotlight on the enthusiasts (both within owner organization and advisors).	• Develop convincing arguments for nZEB.
Increase competitiveness	• Research projects which focus on combining best innovations on component level in order to make more efficient retrofitting processes. • Smart changes of floor plan can improve the area efficiency per employee. Also smart extensions of the existing building, for instance add an extra floor on the top may also improve the economy of the project.	• Better initial audits of the building will reduce the amount of unforeseen challenges. • Systematic training programs to update the skills of all personnel involved in the projects; from planning, construction and hand over/use. • Use of QA tools to assure the quality of a) products/systems, b) competence of the involved actors and c) processes.
Make it more affordable	• Offer of ESCO contracts where the owner pays in accordance with the energy savings obtained.	• Offer of financing as part of the upgrading package.
Make it more available	• Spread the experiences to new regions so new potential clients can see good examples in their neighbourhood. • Make sure the top management of building owner companies see the benefits of nZEB upgrading and as a consequence they will be more open to such initiatives within their own projects.	• As it is a challenge to do deep retrofitting while the tenants stay in the building, use of prefabricated solutions may reduce the level of disturbance as well as the length of the on site retrofitting process.

▲ **Table 2: How the industry can contribute to increasing the number of nZEB retrofitting projects.**

continued on page 12

Market Opportunities and Barriers

As SHC Task 47 participants worked to identify the barriers and opportunities in the renovation process, it was important that they also identified the main barriers and how to address them to make the renovations attractive, affordable, cost effective and more accessible.

The methodologies applied to identify the barriers and driving forces included desktop studies of available building stock information and ownership structures in partner countries, interviews and in-depth descriptions of the decision-making processes used in ten case studies from six of the participating countries.

By systematically studying the drivers and barriers, suggestions for how to strengthen the drivers and eliminate or reduce the barriers were developed. The following tables present recommendations to authorities and industry.

▲ **This Italian school is of the 19 exemplary renovation project brochures available online.**

The points in red text in Table 2 are the same as the recommendation to authorities, meaning that for these actions joint efforts should be undertaken. Of course, the other points work in conjunction with the measures that need to be taken by authorities.

The final decision regarding a project's level of ambition will always be made by the owner of the building. Learning from Carlson & Wilmot's "The Five Disciplines for Creating What Customers Want," there are five principles that should be in place for a successful nZEB renovation project:

1. A holistic understanding of the tenant's needs – which normally encompasses more than just energy efficiency,
2. Solutions offering values that completely fulfill the needs,
3. One or more enthusiastic person who is committed to the process,
4. A multi-disciplinary team (including occupants), and
5. Project support by top management and in line with the company strategy.

To read more about the Task's results and exemplary renovation projects visit the SHC Task 47 webpage. Here you will find four free publications:

- *Lessons Learned from 20 Non-Residential Building Renovations* (52 pages)
- *Market Change: Upgrading of the Non-Residential Building Stock Towards Sustainable Standard. Recommendations to authorities and construction industry* (59 pages)
- *Sustainable Refurbishment School Buildings – A Guide for Designers and Planners* (331 pages)
- *Assessment of Technical Solutions and Operational Management for Retrofit of Non-Residential Buildings* (to be published 2nd quarter of 2015)

This article was contributed by Fritjof Salvesen of Asplan Viak AS, Norway and Operating Agent for SHC Task 47. For more information and to download the free reports go to http://task47.iea-shc.org/.

What Market Adoption of NetZEBs Need

To mainstream market adoption of NetZEBs, what is needed is a wide consensus on clear definitions and agreement on the measures of building performance that could inform "zero energy" building policies, programs and industry building practices, as well as design tools, case studies and demonstrations that would support industry adoption.

Over 40% of primary energy use and 24% of greenhouse gas emissions[1] are attributed to worldwide energy use in buildings. Energy use and emissions include both direct, on-site use of fossil fuels as well as indirect use from electricity[2], district heating/cooling systems and embodied energy in construction materials.

Given the global challenges related to climate change and resource shortages, much more is required from the building sector than incremental improvements in energy efficiency.

The convergence of the need for innovation and requirements for drastic reductions in energy use and greenhouse gas emissions in the buildings sector is transforming the way buildings and their energy systems are conceived and built. Since the early 1990s the idea of net-zero energy buildings has been gaining widespread acceptance as a technically feasible long-term goal for the buildings sector – becoming part of the energy policies of several countries.

The recast of the EU Directive on Energy Performance of Buildings (EPBD), set the framework and boundaries for new buildings to achieve "nearly zero energy" targets by the end of 2020. For the Building Technologies Program of the US Department of Energy, the strategic goal is to achieve "marketable zero energy homes in 2020 and commercial zero energy buildings in 2025". On a state level, California has committed to making all new commercial buildings and 50% of existing commercial buildings net-zero by 2030. While case studies have clearly shown that net-zero energy buildings could be created using existing technologies and practices, most experts agree that a broad scale shift towards net-zero energy buildings will require clear policy frameworks and significant adjustments to prevailing market structures.

However, despite the emphasis on the goals, the definitions remain in most cases generic, but the basic steps to achieving net-zero targets are clear: *make the building as energy-efficient as possible through integrated design and energy-saving technologies, add renewable energy on-site and ensure optimal building performance over time.* Policymakers who wish to support the broad diffusion of net and near zero energy building's will need to determine what kind of regulatory framework is most appropriate for their jurisdictions.

Potential

Around the world, green building is accelerating as it becomes viewed as a long-term business opportunity. Fifty-one percent of the architects, engineers, contractors, owners and consultants anticipate that more than 60% of their work will be green by 2015, up from 28% of firms in 2012. And the growth of green is not limited to one geographic region or economic state – it is spreading throughout the global construction marketplace.

The goal of net-zero may have been once considered an unattainable, far-reaching and expensive proposition, only available to the most technically advanced projects, but now it is within the realm of possibility[4] for the new-build and retrofit markets. The process of achieving net zero energy for an existing building is somewhat similar to that of deep energy retrofits, but with additional considerations: adopting a whole-building analysis process that delivers much larger energy cost savings – sometimes more than 50% reductions.[5] Navigant Research forecasts that global revenue for energy efficiency commercial building retrofits will grow from $68.2 billion in 2014 to $127.5 billion in 2023.

Net-zero energy has been achieved in a number of new and, while more challenging, existing buildings. The main differences for achieving net zero energy for existing buildings are that orientation, site configuration and systems are 'predetermined and for the most part fixed'[6]. Nonetheless, the overwhelming consensus about achieving net-zero energy is most likely to be feasible in:

- Low energy single family homes (new and retrofitted) with appropriate roof orientation and low energy demands;
- Sub-tropical and moderate climate zones, where the use of natural convection and shading strategies could offset most of the building's energy load;

continued on page 14

[1] IEA Promoting Energy Efficiency Investments – case studies in the residential sector ISBN 978-92-64-04214-8. Paris. 2008

[2] Note: In most countries, indirect emissions are not counted as emissions from the building sector but from the industry (power plants). This means the environmental footprint of building related energy use is often underestimated.

[3] McGraw Hill Construction, World Green Building Trends: Business Benefits Driving New and Retrofit Market Opportunities in 60 countries, SmartMarket Report, 2013.

[4] C. Carmicahel, K. Managan, Reinventing Existing Buildings: Eight Steps to Net Zero Energy, Rocky Mountain Institute, Johnson Controls, May 2013.

[5] Ibid.

NetZEBs *from page 13*

BUILDING SYSTEM DESIGN & OPERATION	CURRENT BUILDINGS	SMART NetZEBs
Building fabric/envelope	Passive, not designed as an energy system	Optimized for passive design and integration of active solar systems
Heating, ventilation and air conditioning (HVAC)	Large oversized systems	Small HVAC systems optimally controlled, integrated with solar systems, combined heat and power, seasonal storage and district energy
Solar systems/renewable generation	No systematic integration – an afterthought	Fully integrated: daylighting, solar thermal, photovoltaics, hybrid solar, geothermal systems, biofuels linked with smart microgrids
Building automation systems	Building automation systems not used effectively	Predictive building controls to optimize comfort and energy performance; online demand prediction / peak demand reductions
Design and operation	Design and operation of buildings typically considered apart	Design and operation of buildings fully integrated and optimized together subject to satisfying comfort

- Low-rise buildings (residential and office) (one- to three-story). It becomes more difficult to achieve the net-zero energy target in buildings with more than three floors due to limited roof area and the use of elevators[7]; and
- Buildings with low plug process loads.

Current Barriers

A key requirement of NetZEBs is the need for rigorous design and operation of a building as an integrated energy system that must have good indoor environment suited to its function. If NetZEBs are to become standard building practice, then the design practice needs to change from the traditional linear process to an integrated design approach, bringing together the architects, structural, electrical and mechanical engineers, general contractors and other stakeholders to bear down on the design process. The design of smart NetZEBs requires the following three key approaches :

1. An integrated approach to energy efficiency and passive design.
2. An integrated approach to building design and operation. Optimized NetZEBs need to be designed based on anticipated operation so as to have a largely predictable and manageable impact on the grid;
3. A building design optimizes for solar harvesting. The concept of solar optimization requires optimal design of building form with equatorial facing façades and roofs for conversion to solar electricity, useful heat and daylight."

The key challenges/barriers for NetZEBs to overcome are summarized in the table below (contributions from Subtask B) for each of the five major building subsystems, where the current situation is contrasted with the expected characteristics of NetZEBs.

Actions Needed

To make NetZEBs a reality, designers will need the tools to design and apply better integrated equipment, manufacturers will need to produce high efficiency equipment and develop the know-how to integrate them into buildings, and both will have to carefully monitor occupants; needs and provide comfortable living conditions.

The industry needs to: 1) develop pathways to fully integrate equipment and renewable energy technologies to optimize their value the building; 2) deploy ultra-high efficiency equipment and systems that minimize energy use in all seasons; 3) develop more refined design tools for architects, engineers and manufacturing companies for properly sizing and selecting appropriate HVAC equipment in NetZEBs; 4) enhance building automation systems and controls to achieve better comfort control with less energy; 5) improve building design and selection of low-emitting materials and furnishings along with advanced air filtration and treatment technologies to allow for better control of indoor air quality; 6) set standards for measuring the performance of integrated systems within the building; and 7) train employees in new construction techniques and quality control procedures.

Finally, a number of market-oriented initiatives should be pursued to encourage adoption of NetZEB technology and also to support NetZEB marketing activities. The four main priorities include: 1) building certification (plaque, label or certificate that could be displayed prominently in the building) that could serve to inspire building owners and designers; 2) accreditation of professionals; 3) virtual dashboards that highlight energy flows and consumption of a given NetZEB for communication and educational purposes; and 4) available information (publications, handbooks, guidelines, other) to motivate NetZEB practitioners.

This article is excerpted from the IEA SHC Position Paper on Net Zero Energy Buildings, which will be available on the IEA SHC website in June 2015. The paper builds upon the concepts developed in the context of the joint IEA SHC Task 40/IEA EBC (Energy in Buildings and Communities Program) Annex 52: Towards net Zero Energy Solar Buildings (http://task40.iea-shc.org/).

TASK 40 / ANNEX 52

[6] Ibid.
[7] Ibid.
[8] A. Athientis and W. Obrien (eds.), 2015, Modeling, Design and Optimisation of Net-Zero Energy Buildings, Ernst & Sohn, Berlin, Germany.
[9] ASHRAE Vision 2020: Producing Net Zero Energy Buildings, A Report from the American Society of Heating, Refrigeration and Air-Conditioning Engineers, January 2008.
[10] Ibid

Netherlands

High Energy in a Low Country

Within the next 20 years the supply of fossil fuels, mainly oil and gas, will not be sufficient to provide for the world's economies. Anticipating this shortage, the Dutch government policy focuses on a completely sustainable energy supply system by 2050. Renewable heat and heat storage will be key issues to achieve this goal.

With a high energy demand and a spirited mind, both Dutch scientists and businesses are working on new and innovative energy initiatives. The Energy Agreement for Sustainable Growth, drawn up in 2013, is guiding this change and the Netherlands Enterprise Agency (RVO.nl) is implementing the policies. In this Agreement, a 16% share of renewable energy is foreseen in 2023 compared to the current 4.5% share. In this article, the work of Dutch experts in the field is highlighted to show practical examples of new solar energy and energy in buildings (research) results. All these activities are contributing to the goals set for renewable heat in the Netherlands.

▲ **Solar Island in Almere with 7,000 m² of solar collectors was the first solar district heating system in The Netherlands.**

Joined Forces for Reaching Goals

Holland Solar, the Dutch association for solar thermal and PV, supports and promotes the application of solar energy by organizing campaigns and events, ensuring the quality of solar applications and serving the interests of its 130 members. Erik Lysen, Chairman of the Board of Holland Solar (and the Dutch representative in the IEA SHC Executive Committee from 1992 to 1995) remarks that, "The Dutch solar energy sector is really active and the members of our solar thermal section frequently meet to discuss new developments in the field and how we can achieve the agreed upon goal to grow from the present 1 PJ contribution by solar thermal to an ambitious 6 PJ in 2023."

And Action!

A broad range of measures are proposed to reach this Energy Agreeement goal, some of which are implemented already: product innovations, incentives to reach the rental housing sector, exploiting benefits of the EU Ecodesign and new tax incentives as well as more aggressive market strategies targeting wellness centers, sport clubs, schools, farms and new industrial applications, for example.

The Challenge

The largest heating demand is in the building stock, both for space and for water heating. The challenge here is to increase the contribution of solar thermal. For example, by introducing combi-systems, promoting and implementing seasonal storage and by allowing solar thermal

continued on page 16

▲ **Installing a typical Dutch roof integrated solar collector.**

Netherlands *from page 15*

systems to feed into district heating systems. A good example is the 'Solar Island' in Almere, where a large 5 MW solar heating system (7,000 m^2) feeds into a district heating system for 2,700 homes. "Besides these types of developments, we also expect an increase in the application of solar thermal because of the tighter European directives on net zero energy housing in 2020," says Erik Lysen.

▲ **A Net Zero refurbishment: before (left) and after (right).**

Sustainable and Beautiful 'New' Houses

Net zero refurbishment is the core business of Transition Zero, an initiative of Platform31 commissioned by the Dutch Ministry of Home Affairs. "We brokered a deal between housing associations and builders to refurbish 111,000 houses to Net Zero Energy (E=0) levels in the Netherlands," says Harmke Bekkema, Programme Secretary at Energiesprong-Platform31.

A Unique Construction

E=0 means that a house consumes less energy for heating, hot water, lights and appliances than it produces in a year. The refurbishments are financed from these energy cost savings. In other words, participants hand in their energy bill for a period of 25-40 years. In exchange, they get a loan for the Net Zero refurbishment. This "barter" means that the residents can live in an improved, more sustainable and more attractive home. A refurbishment is completed within just 10 days and comes with a 30-year energy performance warranty from the builder. "A fairly unique construction!" notes Harmke Bekkema.

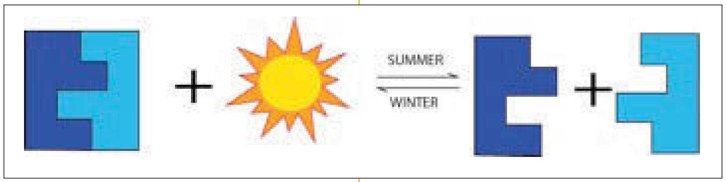
In Constant Development

Large innovation shifts are made in process, technique and financing. Important preconditions are registered in legislation, which enables housing associations to rent the residences, including the energy costs.

Exporting E=0

A consortium of Transition Zero, 10 partners and 17 social housing organizations across France, the UK and the Netherlands are preparing a cross-country program to make E=0 refurbishments a market reality in each of these countries. Harmke Bekkema remarks, "What a fantastic and feasible challenge!"

Compact Storage: Research is Key



▲ **Principal of thermochemical materials (TCM).**

"Until now, there has been no real cost-effective compact storage technology based on the reversible water vapor sorption process of salt hydrates. At least not for commercial use" says Camilo Rindt, Associate Professor at Eindhoven University of Technology and working group leader in *IEA SHC Task 42: Compact Energy Storage*. "For high solar fraction systems, hot water storage is generally not applicable because of space requirements. Therefore, we need to find a way to reduce the volume by searching for phase change materials (PCM) and thermochemical materials (TCM) with a higher specific energy storage density and low material costs. Besides that, more compact storage requires new reactor designs."

Numerical Modeling

To reach high solar fractions, it is necessary to store heat (or cold) efficiently for longer periods of time. "Seasonal heat storage is one of the most promising methods to do this," explains Camilo Rindt. During winter the sorption material is hydrated releasing heat and in summer the material is dehydrated by solar heat. Basically, this cycle can be repeated over and over again. The goal of this research is to gain more physical insight into the limiting transport properties of vapor and heat.

continued on page 17

Netherlands *from page 16*

The results are being used to set up design guidelines/numerical models for new solid sorption materials and more compact heat storage systems. Eindhoven University of Technology aims to launch a pilot project on seasonal heat storage in the built environment within the next five years.

Team Work

"Around the world, it seems researchers are working on either thermal energy storage materials or applications. We are bringing these two fields of expertise together in SHC Task 42, which is crucial for finding the best solution for compact storage of thermal energy," according to Camilo Rindt.

▲ **BIPV project SolarBeat. Left PVT panels, middle PV panels and right 3 PVT panels and 3 solar thermal collectors.**

Solar Thermal and PV – Best of Both Worlds

"Energy consumption in Dutch households consists of one third electricity and two thirds heat," explains Corry de Keizer, project manager at Solar Energy Application Centre (SEAC) "so there's a need for a lot of (sustainable) heat!" PV systems, which only generate electricity, are far more popular in the Netherlands, but a standard PV system only converts approximately 15% of the solar irradiation into electricity and 75% into unused waste heat. Therefore, the combination of PV and solar thermal applications is very logical, but in practice there are still some challenges to overcome.

Make Your Wish (Roof) Come True

SEAC helps companies develop their solar ideas. One such project is WenSDak (roughly translated means Wish Roof, the roof you wish for). Several project partners will develop five different product concepts for Building Integrated PV Thermal (BIPVT) roofs in different market sectors. A field test roof is set up to measure the thermal and electrical energy yield of the BIPVT roofs for different user profiles and system configurations. The collected data will then be used in computer simulations to figure out what produces the most beneficial output.

Ready, Steady… GO!

Project WenSDak will be considered successful when the measurements can be used by the companies involved to predict which applications are likely to be the most beneficial. "There is still so much to be learned from both solar power and solar heat performances. Right now we are installing the systems and by the third quarter of this year the first results are expected. SEAC is also investing in an outdoor field test environment to facilitate research on solar thermal systems in the Netherlands. Did I mention we strive to develop aesthetic BIPVs in all our projects as well?" concludes Corry de Keizer.

The Best Is Yet To Come?

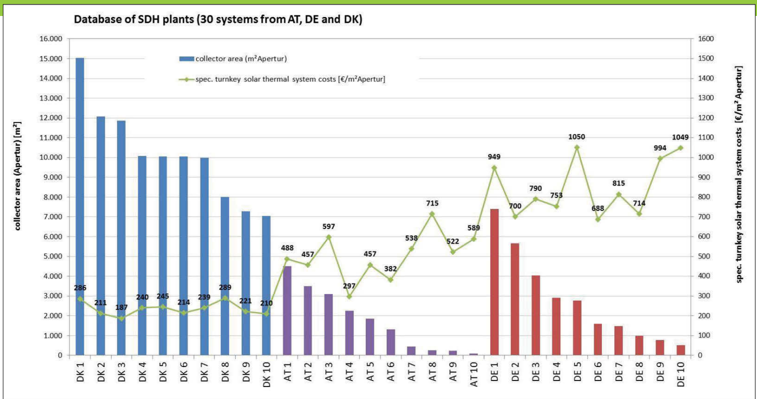
Renewable heat plays a major role in the renewable energy policy of the Netherlands and will continue to do so as demonstrated by the government's April 2015 Heat Vision for the country. As highlighted in this article, many parties are trying their best to reach the goals set in the Energy Agreement by being bold and innovative. "All these efforts should make it possible to increase the market share of solar energy and renewable heat in the Netherlands – a necessity for a sustainable future," concludes Lex Bosselaar.

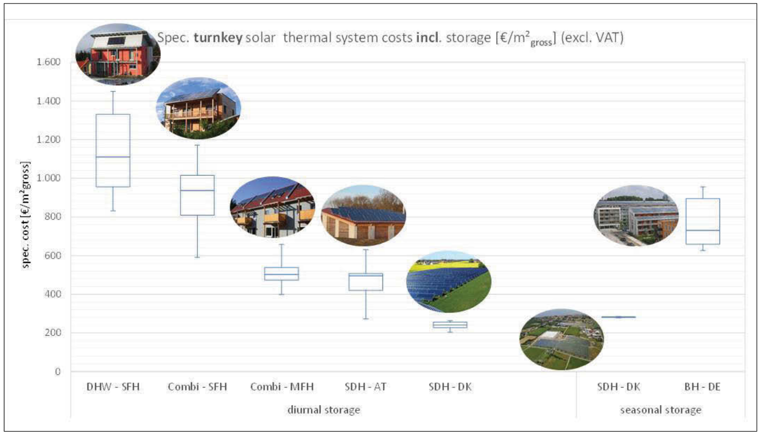
This article was contributed by Lex Bosselaar, the Dutch IEA SHC Executive Committee member. For more information on the Dutch activities contact Mr. Bosselaar at lex.bosselaar@rvo.nl.

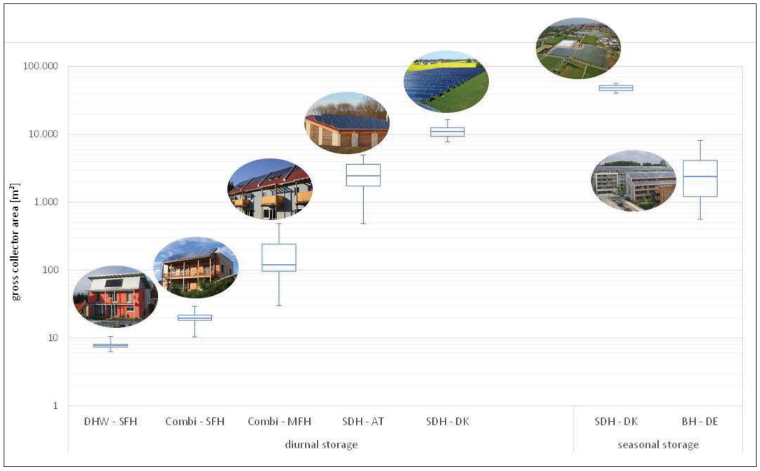
The Solar Heating and Cooling Programme is not only making strides in R&D, but also impacting the building sector. This section of the newsletter highlights solar technologies that have been developed or conceptualized in a SHC Task and are now being commercially manufactured, marketed or used.

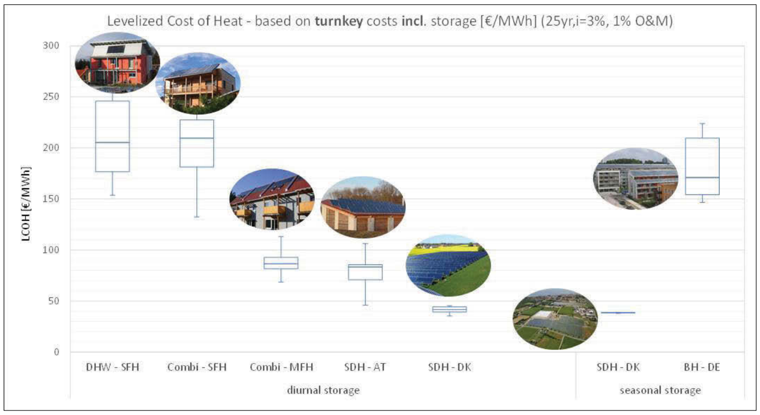
Cost Analysis of Solar District Heating Plants

In the framework of a market survey on existing Solar District Heating (SDH) plants in Austria, Denmark, Germany, today's cost for large systems were collected and analyzed by experts in *SHC Task 52: Solar Heat and Energy Economy in Urban Environments*. Significant differences can be seen in the countries evaluated. In Denmark turnkey solar thermal system costs are the lowest due to standardized system concepts, scaling effects and the availability of cheap land for collector field placement on ground. In Austria and Germany several SDH plants have been built as well, but other than in Denmark, only a small niche market is served. On average the systems in Austria and Germany are smaller than in Denmark, demand individual engineering and are mostly roof-mounted. Among other issues (e.g., efficiency of the DH network served) this leads to higher investment costs and consequently to higher costs for heat generated compared to Denmark.

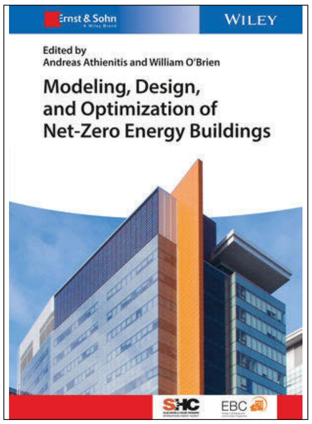








IEA SHC has a new addition to its book series - Modeling, Design, and Optimization of Net-Zero Energy Buildings. In this book, accomplished international experts present advanced modeling techniques as well as in-depth case studies in order to aid designers in optimally using simulation tools for net-zero energy building design. The strategies and technologies discussed in this book are also applicable for the design of energy-plus buildings. The IEA SHC book series is a collaborative endeavor with the publisher Wiley.



Modeling, Design, and Optimization of Net-Zero Energy Buildings

Building energy design is currently going through a period of major changes. One key factor of this is the adoption of net-zero energy as a long-term goal for new buildings in most developed countries. To achieve this goal a lot of research is needed to accumulate knowledge and to utilize it in practical applications. In this book, accomplished international experts present advanced modeling techniques as well as in-depth case studies in order to aid designers in optimally using simulation tools for net-zero energy building design. The strategies and technologies discussed are also applicable for the design of energy-plus buildings.

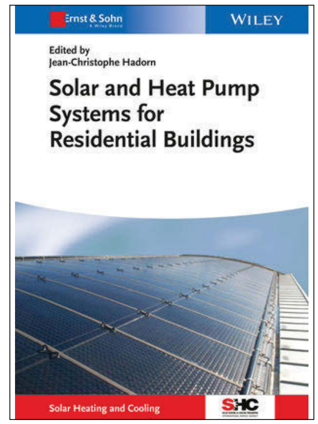
Written by both academics and practitioners (building designers) based in North America and Europe, this book provides a very broad perspective. It includes a detailed description of design processes and a list of appropriate tools for each design phase, plus methods for parametric analysis and mathematical optimization. It is a guideline for building designers that draws from both the profound theoretical background and the vast practical experience of the authors.

After presenting the fundamental concepts, design strategies, and technologies required to achieve net-zero energy in buildings, the book discusses different design processes and tools to support the design of net-zero energy buildings (NZEBs). A substantial chapter reports on four diverse NZEBs that have been operating for at least two years. These case studies are very high quality because they all have high resolution measured data and the authors were intimately involved in all of them from conception to operating. By comparing the projections made using the respective design tools with the actual performance data, successful (and unsuccessful) design techniques and processes, design and simulation tools, and technologies are identified.

This book is the result of collaborative R&D in the IEA SHC and IEA EBC (Energy in Buildings and Communities Programme) through the joint *SHC Task 40/EBC Annex 52: Towards Net Zero Energy Solar Buildings.* More than 80 experts from 20 countries participated in this research.

Andreas Athienitis (Editor), William O'Brien (Editor); ISBN: 978-3-433-03083-7; 396 pages; March 2015.

Solar and Heat Pump Systems for Residential Buildings

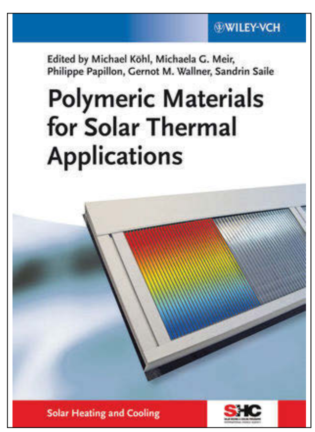


The combination of heat pumps and solar components has great potential for improving the energy efficiency of house and hot water heating systems. This book is the first one about this combination of components and presents the state of the art of this technology.

This book compares different systems, analyzes their performance and illustrates monitoring techniques. It helps the reader to design, simulate and assess solar and heat pump systems. Good examples of built systems are discussed in detail and advice is given on how to design the most efficient system.

This book is the result of collaborative R&D in the IEA SHC and the IEA HPP (Heat Pump Programme) through the joint *SHC Task 44/HPP Annex 38: Solar and Heat Pump Systems*. More than 50 experts from 13 countries participated in this research. The book will be available in August 2015. Pre-orders now being taken for the August 2015 publication date.

Jean-Christophe Hadorn (Editor); ISBN: 978-3-433-03040-0; 274 pages; August 2015.



Polymeric Materials for Solar Thermal Applications

Bridging the gap between basic science and technological applications, this is the first book devoted to polymers for solar thermal applications. Clearly divided into three major parts, the contributions are written by experts on solar thermal applications and polymer scientists alike. The first part explains the fundamentals of solar thermal energy especially for representatives of the plastics industry and researchers.

continued on page 20

New ISO Partnership Promotes Solar Energy Standards

The IEA SHC recently formalized its relationship with ISO TC 180, which creates a clear path for IEA SHC results to be implemented in ISO standards.

"Measuring the solar resources available for solar applications is an important goal of this partnership," says Ms. Erandi Chandrasekare, Secretary of ISO TC180 *"As well as improving the performance of solar heating and cooling systems by standardizing the measurements of performance, reliability and durability."*

In 2015 IEA SHC and TC 180 will collaborate in two areas. The first is to improve the next version of the ISO 9806 standard on test methods for assessing the durability, reliability and safety of glazed and unglazed solar thermal collectors and air heating solar collectors. *"Using this standard as a basis, IEA SHC is working on a global certification scheme for solar water heaters,"* explains Jan Erik Nielsen, SHC project leader. *"We are also promoting the new ISO standard for collector test methods in promising solar thermal markets."*

The second is to improve solar radiation measurement standards. *"IEA SHC is working to develop measurement best practices of the solar resource using innovative measurement technologies,"* says Dave Renné, SHC project leader, *"and the project results will support the establishment of an ISO standard for obtaining quality solar resource data with which to evaluate system performance."*

For **IEA SHC**, this partnership opens another avenue to reach out to industry, government and consumers as the research results are taken up in standards.

For **ISO TC 180**, this partnership gives access to a well-developed international network of experts willing to assist in ISO TC 180 projects.

For **consumers**, this partnership means improved quality, reliability and durability of solar thermal products.

SHC Book Series *from page 19*

Part two then goes on to provide introductory information on polymeric materials and processing for solar thermal experts. The third part combines both of these fields, discussing the potential of polymeric materials in solar thermal applications, as well as demands on durability, design and building integration. With its emphasis on applications, this monograph is relevant for researchers at universities and developers in commercial companies.

This book is the result of collaborative R&D in the IEA SHC through the *SHC Task 39: Polymeric Materials for Solar Thermal Applications.*

Michael Köhl (Editor), Michaela Georgine Meir (Editor), Philippe Papillon (Editor),Gernot M. Wallner (Editor), Sandrin Saile (Editor); ISBN: 978-3-527-33246-5; 418 pages; November 2012.

New Publications Now Online

Don't miss out on reading, using and referencing these important IEA SHC publications.

Large Solar Systems

Fact Sheets

IEA SHC Task 45 has published a series of "Fact Sheets."

- INFO SHEET: A 1-2 page introduction and summary of a technical topic
- TECH SHEET: A detailed multipage report/ guideline on a technical topic.

Solar Cooling

State of the Art on New Collectors & Characterization for Solar Cooling

An extensive market overview of existing concentrating collectors was conducted to create an easy to consult database (similar to Solar Keymark for certified collectors). New components and approaches, currently under development, have been included and their use in existing solar cooling plants investigated.

Pump Efficiency and Adaptability

This technical report focuses on pump efficiency and adaptability to part load conditions in order to minimize the electricity consumption in the hydraulic circuits to obtain a high seasonal energy efficiency ratio in solar cooling systems.

Heat Rejection Systems for Solar Cooling

This overview looks at existing and novel concepts for heat rejection devices in solar cooling systems and provides recommendations on which heat rejection measure should be used under different boundary conditions (climate, system concept etc.) while achieving the two main objectives of investment and operation costs minimization and re-cooling performance and efficiency.

Advanced Lighting Solutions for Retrofitting Buildings

IEA SHC Task 50 Newsletter #1

This IEA SHC project on lighting published its first newsletter. This issue includes articles on by-passing barriers for lighting retrofits, database of lighting retrofit technologies, lighting retrofit in current practice and results of lighting survey, and the first application of a new monitoring protocol.

Solar Renovation

Lessons Learned from 20 Non-Residential Building Renovations

This report summarizes the findings from 20 exemplary renovation projects. The buildings are divided into three categories; educational buildings, office buildings and historic & protected buildings. In this summary chapter, the key findings from all the buildings are described. More detailed information for each building category is presented under the respective chapters.

Sustainable Refurbishments, School Buildings

The lack of comfort in most school buildings has negative and scientifically proven consequences on pupils' concentration and learning. This guide provides designers with information and resources needed to retrofit school buildings in a sustainable and efficient way. The book is richly illustrated with explanatory diagrams and pictures.

Market Change: Upgrading of the Non-Residential Building Stock Towards Nzeb Standard

This report includes desktop studies of available building stock information and ownership structures in partner countries. Interviews and in-depth descriptions of decision-making processes used in case studies from the participating countries were carried to identify trends, commonalities and differences across the participating countries and draw conclusions about the decision making process.

Solar Resource Assessment and Forecasting

Best Practices Handbook for the Collection and Use of Solar Resource Data for Solar Energy Applications

The second edition is an update of the original handbook with the addition of a condensed form of the state of the art for all users. Published by the US National Renewable Energy Laboratory (NREL), this version includes the contributions of the international team of SHC Task 46 experts. Readers are encouraged to provide feedback to the authors for future revisions and an expansion of the handbook's scope and content.

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 53 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

Vol. 61, May 2015

Prepared for the IEA Solar Heating and Cooling Executive Committee

by

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