SHC SOLAR UPDATE VOL.47 | JULY 2007

Newsletter of the International Energy Agency Solar Heating and Cooling Programme

Advanced Housing Renovation

Buildings are responsible for up to 35 percent of the total energy consumption in many IEA countries. And, housing is the largest energy consumer in the building sector. When houses are renovated to meet contemporary expectations and lifestyles or to repair existing construction there is the opportunity to reduce the building's energy use often at marginal extra costs.

Many exemplary renovation projects have been completed, but the experience gained has not been systematically analyzed and many projects are at best only locally known. Because most property owners are not even aware how far energy demand can be economically reduced, they too often set mediocre goals. This is a missed opportunity to prepare buildings for the future energy era. To address this void, the SHC Programme's *Task 37: Advanced Housing Renovation with Solar & Conservation* is working to develop a solid knowledge base on how to renovate houses to a very high energy standard and to develop strategies that support the market penetration of these renovations.

SHC Task 37 is analyzing and will publicize the results of many successful renovation projects. Based on this analysis, innovative concepts will be identified and further developed for the most important housing market segments. The global environmental impact of such solutions will also be examined. Priority is being given to housing types and concepts that have significant potential for replication and strategies will be developed to increase the market introduction of energy efficient renovation..

The Task is in its first year and has more than 40 experts from Austria, Belgium, Canada, Denmark, Finland, Germany, Italy, Netherlands, Norway, New Zealand, Sweden and Switzerland.

The analysis of successful renovation projects is underway and experts have agreed upon a set of criteria for selecting demonstration projects.

Occupancy types:	All forms of housing including mix uses.
Concept:	Something innovative enough for international publication.
Energy:	Max primary energy for space heating and associated technical installations (fans, pumps, etc.): 60 kWh/m^{2}. Opaque envelope insulation < 0,25 W/m^{2}K (if possible, should not exclude special buildings, for example, historical buildings).
Economics:	Marketable solutions.
Design:	Substantial improved living quality.

This past April, a workshop was held in Switzerland to present 12 renovation projects from 6 different countries. Some of these projects will be

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In This Issue

solar facades

5-year project concludes

SHC Task 27 on the Performance of Solar Facade Components, has concluded its work. Experts from 14 countries collaborated for five years to determine the solar, visual and thermal performance of materials and components. Their work included simulations, case studies, energy performance methodologies, durability test procedures, and environmental impact assessments.

Building on the results of *SHC Task 18, Advanced Glazing Materials,* and the *Materials in Solar Thermal Collectors Working Group*, experts from Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Portugal, Sweden, Switzerland, and the United States worked to determine the solar, visual and thermal performance of different materials and components. Experts also worked to promote an increased confidence in the use of these products by developing and applying appropriate methods to assess their durability, reliability and environmental impact.

To manage the large scope of this work, the Task was divided into three Subtasks:

Performance of Solar Façade Components, which focused on:
- Energy performance assessment methodology
- Energy efficiency of switchable glazing in office buildings
- Solar building components and integrated assemblies

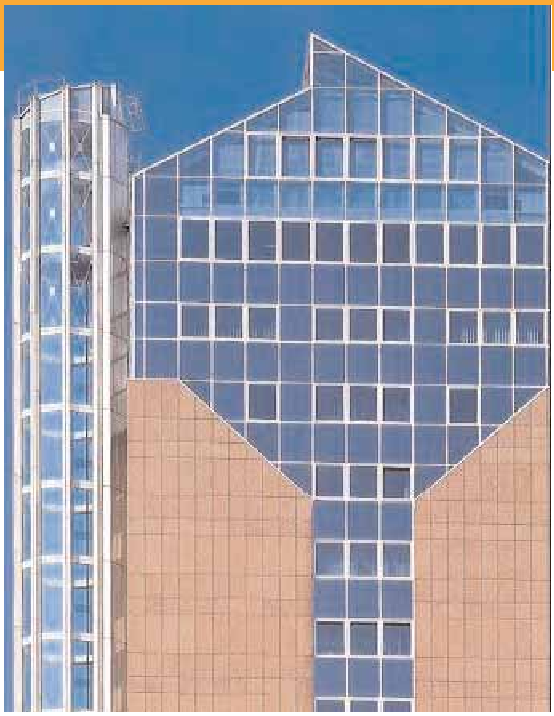
Durability, which focused on:
- Durability assessment methodology
- Durability and reliability assessment of switchable materials and devices (chromogenics)
- Assessment of durability and service lifetime of static solar energy materials

Sustainability, which focused on:
- Environmental performance
- Failure mode analysis
- Durability of windows

Highlights of Key Results

Energy Efficiency of Switchable Glazing in Office Buildings

Over the past two decades there has been a trend to use more glass as façade elements in large office blocks. This inevitably leads to overheating during the summer even in northern climates, unless careful solar shading is included in the building concept. Unfortunately, the easy way out is to install expensive and power consuming air-conditioning units.



A new and exciting solar shading alternative is to use switchable windows, also called smart windows. These are windows that can switch between high and low transmittance of solar and/or visible radiation. The result being windows that can adapt to varying solar irradiation conditions, maintain high interior thermal comfort, and reduce glare.

To evaluate the energy consumption of an office, Task participants agreed on a suitable standard reference office and several sophisticated building simulation programs. Simulations were conducted in three different European climates--Rome, Brussels and Stockholm--using two identical offices (one facing north and the other south) with two large windows, but not fully glazed facades. The results clearly indicated a large energy saving potential for switchable windows even when compared to advanced static solar control windows.

An especially interesting result of the simulations was that the power needed for cooling could be reduced to almost zero in moderate to cold climates, thus eliminating the need for power-consuming air conditioning and in turn reducing the investment cost.

Window-Wall-Interface

In these case studies, the effects of building integration on the thermal and total solar energy transmittance of windows were investigated. Methods for characterizing the assembly of typical window products and typical wall/roof construction were evaluated and tested using comparative calculations on reference cases. The result of this work was the creation of a methodology to simplify the characterization of window-wall/roof assemblies and their impact on the total solar energy

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selected as Task 37 demonstration projects. During the next six months, brochures of eight Task 37 demonstration projects will be published on the SHC web site.

One of these projects is the rowhouse, Henz-Noirfalise in Eupen, Belgium. This 150-year old house has been transformed into a passive house standard building through a thorough renovation process. Renovation was the preferred option because of a substantially lower VAT (15% lower) and it was possible to reach the passive house standard by only adding a few minor extra measures.

The renovation of this rowhouse included:

- Insulation of the walls, floors and roofs with cellulose.
- Replacement of the single pane glazing with triple glazing and passive house frames.
- Addition of a new balanced ventilation system (heat recovery of 85-90%) with a ground-air heat exchanger.
- Addition of solar collectors and biopellet boiler for space and water heating.
- Use of natural cooling and shading to guarantee a good summer comfort level–cooling providied by the thermal mass of the old building, external shading of the upper floor provided by the solar collectors and on the ground and first floor provided by natural vegetation.

Before

After

The results of the renovation are significant. Before the renovation, energy consumption for space heating was 300 kWh/m^2 and after the renovation it is 15 kWh/m^2 (PHPP – Passivhaus Projektierungs Paket).

More information on advanced housing renovation can be found on the Task 37 web page at www.iea-shc.org or by contacting the Operating Agent, Fritjof Salvesen, at fs@kanenergi.no

Facades *continued from page 2*

transmittance of the window. A number of typical window-wall/roof assemblies in the participating countries were characterized.

New Test Procedure for Collector Absorbers

Solar absorber coatings have become more advanced thus making collectors more efficient. To determine the durability and life of these improved collectors, Task participants developed a test procedure based on an absorber's optical properties (solar absorptance and thermal emittance). By accounting for the absorber coating's optical properties, the stagnation temperature can be determined, which is the main cause of temperature degradation. This new procedure is based on simulated load profiles that depend on the optical properties (solar absorptance and thermal emittance) of the absorbers.

In Task 27, the temperature test procedure developed in SHC Task 10 was modified to allow for a more sophisticated testing of coatings with different absorption and emittance values. By adjusting the test-conditions to the load-profile that can be expected in real applications, the test-conditions are more rigorous than the Task 10 temperature test.

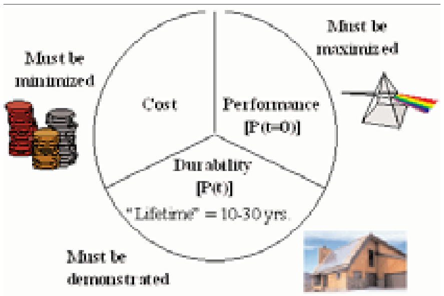
This new test procedure helps manufacturers to reduce their risks and warranties and provides consumers with greater confidence in the products.

Environmental Performance

Studies in this area demonstrated that:

- To achieve improved environmental performance, the system lifetime and efficiency are more important parameters than the choice of manufacturing materials.
- For windows and glazings, more precise data and refined assumptions are required to determine the environmental relevance of a technological improvement and its energy savings.

SHC work focused on cost, performance and durability



For more information on the results of Task 27 visit the SHC web site, www.iea-shc.org or contact the former Operating Agent, Michael Köhl, at michael.koehl@ise.fraunhofer.de.

canada

first solar seasonal storage community in north america

An innovative undertaking in the town of Okotoks, Alberta, could revolutionize how entire communities heat their homes during frigid North American winters. Solar energy will be used to meet greater than 90 percent of residential space heating needs for 52 homes in the Drake Landing Solar Community (DLSC), drastically reducing this community's dependency on fossil fuels as an energy source.

A long-standing barrier to solar-heating technology in cold climates has been the sun's noticeable absence during the winter heating season. Short days, cloudy skies and snow-covered solar panels are major obstacles. Energy experts at Natural Resources Canada's (NRCan's) CANMET Energy Technology Centre (CETC) are working with industry to put the finishing touches on North America's first large-scale solar seasonal storage project to demonstrate that solar heat can be stored from the summer to the winter and is a viable energy source in cold climates. The project, which integrates solar energy, energy efficiency, district heating, and energy storage, is expected to be fully operational mid-2007.

Solar Seasonal Storage in Canada

Solar seasonal storage for space heating is not a new concept in Canada. The first solar seasonal storage system in Canada was designed for a single family house north of Toronto (Provident House) in the late 1970s. This was followed in the early 1980s with a larger system designed for an apartment building in Aylmer, Ontario. Both projects utilized water tanks for heat storage. These systems demonstrated the technical feasibility of solar heating with seasonal heat storage but met limited success for a variety of reasons.

However, recent advances in solar seasonal storage development in Europe coupled with cost reduction in solar collectors in Canada led CETC to re-evaluate opportunities for utilizing solar energy to displace large fractions of fossil fuel for residential space heating on a community scale. The result was a collaborative effort with the DLSC project partners to engineer a community based system that would capture the sun's thermal energy during the summer, store this energy underground, and later retrieve it to provide space heating. The DLSC project is the first solar seasonal storage project in Canada since the 1980s and the first to utilize borehole thermal energy storage.

Collaboration with IEA Experts

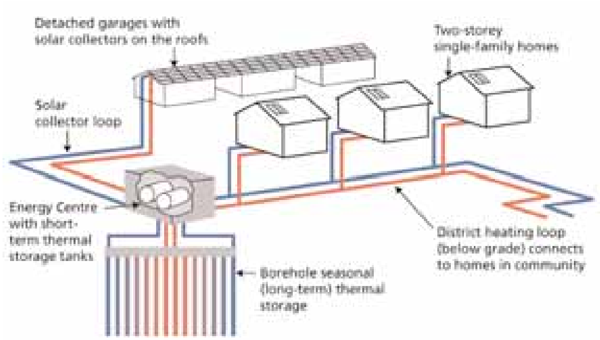
In September 2003, CETC organized a delegation of Canadian project partners for a technical study tour to visit solar seasonal storage projects in three European countries – Sweden, Germany, and The Netherlands. The delegation visited project sites, met with European experts, and were able to apply lessons learned in Europe to the design of the DLSC project in Canada.

Throughout the tour, the design team was able to make key design decisions while studying the European projects. Many impromptu meetings took place during lunches, dinner and train travel. The tour was a success, thanks in large part to the network of experts involved in the Conservation through Energy Storage (ECES) and the Solar Heating and Cooling Programmes of the International Energy Agency.

The Drake Landing System

DLSC consists of 52 single family detached homes located on four streets running east-west. Garages are positioned behind each home and their roofs are linked to neighboring garages, creating a covered breezeway for each home while providing a continuous roof structure to support the solar collectors. A total of 798 flat plate solar collectors are used at DLSC covering an area of approximately 2,300 square meters. The panels will generate 1.5 megawatts of thermal power on a typical summer day.

The Drake Landing Solar Community in Okotoks, Alberta



A schematic of the simple district loop.

"This system significantly reduces greenhouse gas emissions and demonstrates the importance of using clean, renewable energy sources. It's exciting to see a project of this size being realized that will have environmental benefits for the community of Okotoks and will also set an example across North America."

CANADIAN SENATOR TOMMY BANKS

The solar heat is transferred to two large water tanks with a combined water volume of 240 cubic meters located in the community energy centre building. The tanks act as a buffer between the collector loop, the district loop and the underground thermal storage. From there the heat is transferred underground through a series of U-tubes distributed radially in the borehole thermal energy storage (BTES) field. The BTES field consists of 144 holes stretching 37 meters below ground and covering a surface area 35 meters in diameter. Water flows through the U-tubes from the centre to the outer edge when storing heat, and from the outer edge towards the centre when recovering heat so that the highest temperatures will be near the centre to optimize efficiency. Rising to a temperature of 80°C, the underground storage will retain enough energy to heat the community's 52 homes.

An advanced district heating system will retrieve the heat and distribute it on demand throughout the community. Innovative integrated mechanical systems, developed in partnership with CETC, will distribute the heat throughout the homes.

The homes are built to NRCan's energy efficiency R-2000 standard and the Built Green™ Alberta "Gold" standard, and are each fitted with a solar domestic hot water system. Each home will produce five tons fewer greenhouse gas emissions annually than conventionally built homes.

"This system significantly reduces greenhouse gas emissions and demonstrates the importance of using clean, renewable energy sources," said Canadian Senator Tommy Banks. "It's exciting to see a project of this size being realized that will have environmental benefits for the community of Okotoks and will also set an example across North America."

The benefits of this project will be far-reaching. By integrating technologies, the Drake Landing Solar Community will accelerate the development of many of the systems being employed. The participating manufacturers, builders, developers and utilities will gain valuable knowledge, and by eliminating the major seasonal barrier this initiative encourages future investments in the production of renewable technologies.

As a community-wide project, it will give city officials and urban planners an innovative model for solar heating in their "cold climate" Canadian neighborhoods. It will also offer an alternative to conventional fossil fuel-based systems and help address issues of pollution, air quality, and energy supply and security.

The homes in the Drake Landing Solar Community are all sold and 40 are currently occupied. All 798 solar collectors have been installed with 25 percent online and the remainder being tested. The system is scheduled for completion in mid-2007.

CETC is currently preparing plans to expand work in the solar seasonal storage field including looking at larger scale applications, higher density residential and commercial building loads, different thermal storage technologies including aquifers, and applications for single family homes with advanced higher density thermal storage technologies.

This article was contributed by the Canadian Executive Committee member, Doug McClenahan. For more information about the DLSC project, please visit www.dlsc.ca. To learn more about CETC activities in renewable energy technologies and the built environment, visit www.sbc.nrcan.gc.ca.

Drake Landing– An Award Winning Project

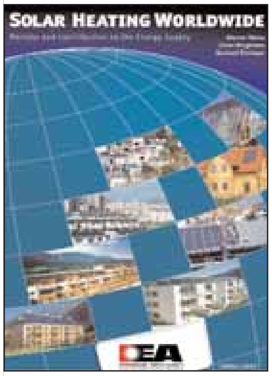
- 2005 Gold Award, International Award for Livable Communities, United Nations
- 2005 Best Idea, Alberta Home Builders Association.
- 2006 Emerald Award for Climate Change, Alberta Emerald Foundation
- 2006 Innovation Award, Alberta Awards for Excellence in Housing
- 2006 Solar Thermal Project of the Year Award, Canadian Solar Industries Association

SHC new publications

Solar Statistics

Solar Heat Worldwide – 2007 Edition

Werner Weiss, Irene Bergmann, Gerhard Faninger



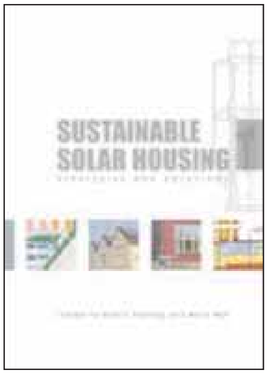
The solar thermal market continues its steady growth and many countries are experiencing substantial growth. This year's edition of the IEA Solar Heating and Cooling Programme's, *Solar Heat Worldwide: Markets and Contributions to the Energy Supply 2005*, presents data from 45 countries. Overall, Solar thermal in 2005 produced energy equalling 66,406 GWh – an oil equivalent of 10.7 billion liters and annual avoidance of 29.3 million tons of CO_2 emissions.

Download your copy from www.iea-shc.org.

Solar Housing

Sustainable Solar Housing - 2 volumes

Edited by Robert Hastings and Maria Wall; Hardback, £67.50



This far-reaching and authoritative two-volume set examines a range of energy conservation and renewable energy solutions for designing low-energy buildings.

Each volume assesses the potential of these options in a variety of contexts, covering different housing types (apartment, row and detached) in cold, temperate and mild climates. The authors are from 14 countries and include a mix of internationally respected academics and practitioners.

Volume 1 – Strategies and Solutions

Volume 1 presents strategies and solutions, offering the reader a solid platform for developing concepts, considering environmental and economic concerns for housing projects in a variety of contexts.

Volume 2 – Exemplary Buildings and Technologies

Volume 2 offers a detailed analysis of exemplary buildings in different European countries and examines the various technologies employed to achieve the remarkable performance. Aided by clear illustrations, it offers invaluable insights into the application of these technologies.

Order your copy at http://shop.earthscan.co.uk

Advanced Storage

Laboratory Prototypes of Thermo-Chemical and Sorption Storage Units

Edited by Chris Bales.

This technical report provides detailed results on four different prototype storage units tested in *SHC Task 32, Advanced Storage Concepts for Solar and Low Energy Buildings*. The key figures for the prototypes are presented together with projected sizes and heat storage densities for hypothetical stores with 70 and 1000 kWh storage for single family homes. In the final section of the report, the prototypes are compared in terms of energy density and material cost.

Download your copy from the Task 32 page at www.iea-shc.org.

Model Testing & Validation

Empirical Validations of Empirical Validations of Shading/Daylighting/ Load Interactions in Building Energy Simulation Tools

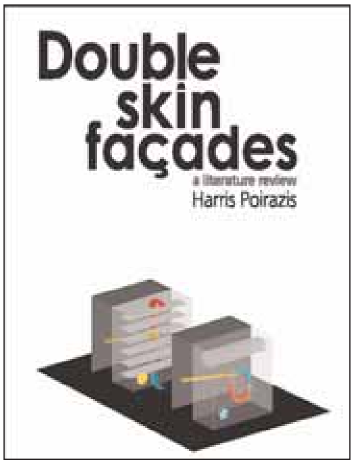
Written by Peter Loutzenhiser, Heinrich Manz and Gregory Maxwell.

These studies are some of the most detailed empirical validations of solar gain models implemented in building energy simulation programs. The purpose of this project was to create data sets for use when evaluating the accuracies of models for glazing units and windows with and without shading devices. Program outputs were compared with experiments performed at an outdoor test cell in Switzerland and a facility in the United States. The authors' intention is that the data are widely used by program developers and modelers for future validation efforts.

Download your copy from the Task 34 page at www.iea-shc.org.

Double Skin Facades: A Literature Survey

Written and edited by Harris Poirazis.



This report describes the concept of Double Skin Façades (DSF) based on different sources of literature and includes an extensive description of modeling approaches and methods for DSF including airflow and thermal simulations. The concept of DSF is complicated and its use and function affect different parameters of the building so the literature studied came from many different fields.

Download your copy from the Task 34 page at www.iea-shc.org.

solar marketplace

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

Old Technology – New Application

SHC Task 33, Solar Heat for Industrial Processes, has taken the **linear Fresnel collector**, a technology which until now has only been discussed for use in large-scale power generation, and adapted it for industrial process heat applications. The linear Fresnel collector uses individually tracked reflector rows to concentrate direct solar radiation onto a stationary linear receiver thus providing an optical concentration that allows for high operation temperatures. This combined with its expected low wind loads, high ground coverage and relatively simple and low cost construction led the German company, PSE GmbH to consider it for producing process heat.

PSE GmbH has developed a roof mountable linear concentrating Fresnel collector to produce process heat up to 200°C starting with a peak capacity of around 50 kWth. In December 2005, the first prototype with a 88 m^2 mirror area was installed in Freiburg, Germany and then monitored through the summer of 2006.

A second prototype with a 132 m^2 aperture area was installed in Bergamo, Italy to power a $NH3/H_2O$ absorption chiller. The complete solar cooling system has been operating and monitored since August 2006. The monitoring results demonstrate the system's reliable operation and a good match between the chillers and the collector.

Both plants have confirmed the expectations of the collector's performance and demonstrate its use for the solar generation of industrial process heat and solar cooling. Other demonstration projects will be undertaken in 2007. And, PSE GmbH plans to offer the collector commercially in 2008.

For more information contact, Dr. Andreas Häberle, PSE GmbH, ah@pse.de, www.pse.de

ANSI/ASHRAE Continue to Adapt SHC Work

The American National Standards Institute (ANSI) and the American Society of Heating, Refrigeration and Air Conditioning (ASHRAE) continue to adopt SHC work into their standards. Published Standard 140-2004 includes adaptations of earlier SHC work conducted by the National Renewable Energy Laboratory (NREL) in the US:

- IEA Building Energy Simulation Test and Diagnostic Method (BESTEST) – developed in *SHC Task 12, Solar Building Analysis Tools*
- HVAC BESTEST Volume 1 – developed in *SHC Task 22, Building Energy Analysis Tools*

The publication of an addenda to Standard 140-2004 is imminent and it will include other SHC work:

- Furnace BESTEST – developed by Natural Resources Canada under *SHC Task 22*
- HVAC BESTEST Volume 2 – developed by NREL under *SHC Task 22*

During 2007, ASHRAE also plans to publish Standard 140-2007, an updated version of Standard 140 and it will integrate the Furnace BESTEST and HVAC BESTEST Volume 2 addenda with the current test suites of Standard 140-2004.

Task 33 Demonstration Project in Bergamo, Italy. The PSE linear Fresnel Process Heat Collector powers two $NH3/H_2O$ absorption chillers.

IEA SHC programme

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 39 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.

Current Tasks and Operating Agents

Advanced Storage Concepts for Solar and Low Energy Buildings
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SOLAR UPDATE
The Newsletter of the IEA Solar Heating and Cooling Programme

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