SOLAR UPDATE

NEWSLETTER OF THE INTERNATIONAL ENERGY AGENCY SOLAR HEATING AND COOLING PROGRAMME • NO. 37 JANUARY 2002

Integrated Design Process Optimizes Solar Design

The work of SHC Task 23 is helping building designers to understand integrated design processes and to carry out optimization exercises, thereby ensuring the most appropriate use of solar energy in the building. At the same time, the Task is working to ensure that the buildings are designed to promote sustainable development.

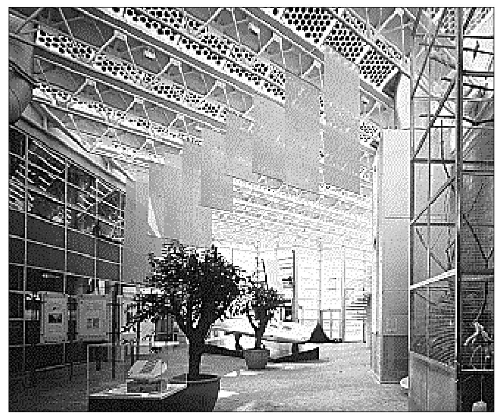
Research and development on energy efficiency and the use of renewable energy in the building sector has, until recently, focused primarily on small-scale, residential buildings. However, this focus is shifting to larger scale, more urban buildings, which is appropriate considering that increasing proportions of the world's population live and work in large cities. In order to substantially decrease the total energy use in urban buildings it will, in most cases, be necessary to use a combination of low energy and solar technologies. And, a key to accomplishing this is to create a multi-disciplinary design team that understands how to design buildings with energy systems that are integral parts of the whole (i.e., a "holistic" or "whole building" approach to building design).

The importance of using an integrated design approach was clearly demonstrated in the Solar Heating and Cooling Programme's Task 13, *Advanced Solar Low Energy Buildings*. To use the lessons learned in this Task, experts are working to promote a "holistic" approach to the building design of commercial and institutional buildings in SHC Task 23, *Optimization of Solar Energy Use in Large Buildings*.

IN THIS ISSUE

Case Studies

The work in SHC Task 23 started with a series of case studies. The main objective of this exercise was to compile the knowledge needed in the development of guidelines, methods, and tools. It was done by evaluating and documenting a set of buildings designed using the "whole building approach." Both the particular processes used in the design of the buildings and the resulting building performances were evaluated. One of the criteria used in selecting the cases was that they represented the relevant building categories in the participating countries.



The Brundtland Center atrium in Toftlund, Denmark. Simulations indicate that the building will use 60% less lighting energy and 85% less heating energy than a conventional Danish office building. In total, the building is expected to use only 48 kWh/m^2 for heating, lighting, and ventilation.

Guidelines and Tools

Results from the Case Studies showed that the work in Task 23 would be useful to the design community and that guidelines on how to carry out integrated design processes were needed. Task participants agreed that dynamic guidelines that address universal issues and an electronic multi-dimensional information system that could serve as a guide through the design process would be the most useful. The guide, called the *Navigator*, is based on the design process activities and dynamically links related issues, actors, and methods and tools relevant for a specific context. It is expected to be further developed over time using experiences gained from projects, companies, and countries.

The Task experts also have developed a method that structures the discussions on which criteria to use in this process. In building design, energy use and environmental impact are only two of the criteria important to the client. There are many others, and the relative importance of each of them will differ from case to case. The Task has therefore looked at tools that take into account any criteria chosen by a client or a design team and has developed a multi criteria decision making method, called *MCDM-23*, and an associated computer program. The *MCDM-23* is a formalized step-by-step procedure to aid in such decision-making processes, while the computer program automates many of the tasks involved in using the method and produces worksheets, bar charts, and star diagrams.

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Solar Thermal Program Heats Up in France

In 2000, ADEME, the French Agency for Environment and Energy Management, launched Helios 2006. This program targets solar hot water production in single-family homes and buildings. Due to this effort and others, solar energy is becoming a common term and everyday sight throughout France.

As a way to help meet Kyoto targets, France established the Helios 2006 program in 2000. This solar program is for solar hot water production in single-family homes and buildings as well as solar combisystems, primarily for homes.

The focus during the first two years of the program has been on individual solar domestic hot water systems. Activities have included systems and installer certification, training courses, and promotion. Beginning in 2002, activities will begin on medium/large-scale solar hot water systems and solar combisystems.

The overall goal of the Helios 2006 program is to install 430,000 m^2. The targets by system are:

	Installed per year	Total installed (by 2006)
SDHW individual units	30,000 units/120,000 m^2	350,000 m^2
SHWmedium/ large-scale systems	15,000 m^2	50,000 m^2
Individual solar combisystems	500 units/8,000 m^2	30,000 m^2

Solar Domestic Hot Water Systems

In addition to certification, labeling and training, the program also provides national incentives through ADEME, the French Agency for Environment and Energy Management. To qualify the system must be certified and installed by plumbers with specified professional skills (the Qualisol Label). The incentives range from 690 to 1,150 euros, depending on the size of the SDHW system. Regional authorities, through partnership with ADEME, also are providing incentives to buyers of SDHW systems. The amount varies considerably, from 450 to 1,150 euros.

The first sign that the market for SDHW systems is expanding can be seen in data from 1999-2002.

	1999	2000	2001	2002 (estimated)
Manufacturers/Importers	3	6	10	14
"Qualisol" installers	46	435	1,250	1,500
Units installed	150	800	2,500	5,000

Solar Combisystems

Starting in 2002, subsidies will be given to several types of "standardized" solar combisystems that have been installed by "Qualisol" certified installers on houses that meet four requirements – operator/manufacturer agrees to participate in the solar combisystem in situ evaluation program; operator/manufacturer has installed at least 10 solar combisystem projects that have be working for more than one year in Europe; the collectors are certified; and the collector area is more than 7 m^2. National subsidies will range from 1,150 to 2,670 euros depending on the type of roof-integrated collector, and its performance, which will be validated through in situ measurements. Individual buyers also will be offered subsidies, very similar to those given for SDHW systems. As with the SDHW, ADEME will try to partnership with Regional Authorities so that additional buyer incentives can be offered. Although it is too soon to determine the success of this component of Helios 2006, data shows a growing interest in combisystems among French citizens.

Sticker for Qualisol plumbers that they can place at their store or on their car.

Cover of Plan Soleil promotional document.

	1999	2000	2001	2002 (estimated)
Solar Combisystems installed (units)	100	120	150	200
Solar Combisystems installed (m^2)	1,500	1,800	2,300	3,000

Medium and Large-Scale Solar Hot Water Systems

To promote the use of solar hot water systems in buildings, such as hospitals, hotels, multi-family dwellings, retirement homes, and sports halls, ADEME is providing subsidies for technical studies. The subsidies for "check up" studies can be for up to 90% of costs with a limit of 2,300 or 3,800 euros depending on the complexity of the study. Many of these studies have been performed over the last two years with the result being an increase in investments in such systems.

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NEW PUBLICATIONS

The SHC Programme has several new reports available on the SHC website at www.iea-shc.org.

SOLAR ASSISTED AIR CONDITIONING OF BUILDINGS

Survey of Solar Assisted Cooling

A database on solar assisted cooling projects in 12 countries has been compiled. This webpage contains short summary reports about solar cooling activities in the participating countries and a database about the projects and systems installed in the past. The address of the webpage is: http://ocuilih.cie.unam.mx/cgi-bin/main_menu.cgi and the password is task25.

DAYLIGHT IN BUILDINGS

Application Guide for Daylight Responsive Lighting Control

Electric lighting and daylight have to cooperate in order to achieve the goals of energy efficiency and good visual comfort. And, daylight responsive control systems help to do just this, however, there are a variety of systems on the market. This guide is designed to help users select, install and maintain a daylight responsive control system.

Measurement of Luminous Characteristics of Daylighting Materials

This report covers measurement characteristics and principles, plus light transmittance and bi-directional measurements and references. It also includes specific performance data.

Applicability of Daylight Computer Modeling in Real Case Studies: Comparison between Measured & Simulated Daylight Availability & Lighting Consumption

This report investigates the accuracy and limitations of the Adeline 1.0 lighting software in simulating the illuminance distribution from daylighting and the electrical lighting energy savings of an existing atrium building. The purpose of the study was to compare the Superlite, Superlink and Radiance computed outputs against data collected in a real building. ✷

France *from page 2*

The impact of this activity is shown below:

	1999	2000	2001	2002 (estimated)
Medium and large-scale solar hot water systems	500 m²	2,100 m²	3,000 m²	4,000 m²

A preschool in Bretagne that is equipped with a medium-sized centralized solar water plant.

Plan Soleil

The "Sun Program" is a solar promotional campaign that complements the efforts of Helios 2006. Plan Soleil was launched in 2000 and at first was restricted to five regions. After the first year, the program was expanded to include four more regions. And now, due to the program's popularity it will be launched in all the remaining regions of France in March 2002.

Plan Soleil is promoting solar energy using the media and different marketing tools. For example, there are spots on regional television and ads in local newspapers. Also, brochures and booklets have been published to explain the basics, such as how the systems work, their cost and the savings they generate, and the environmental benefits. To promote SDHW systems, the program has compiled a list of "validated" SDHW systems and a list of qualified QUALISOL installers. For installers informational meetings and two-day national training programs are offered by ADEME and its regional partners.

The Future

Solar energy is becoming a common term and everyday sight throughout France. As public awareness continues to grow so will consumer demand, and that is what ADEME is counting on. ✷

Integrated Design Process *from page 1*

Table 1 presents the criteria and sub-criteria proposed by the Task participants as a starting point for discussions. As can be seen, some are quantifiable, such as annual energy use. Others are qualitative, such as architectural quality. It is recognized that in other design situations, other criteria may be selected. The method should therefore be applicable to any set of criteria a client or a design team choose to use. In the Task 23 work on solar and energy efficient buildings, set in Table 1 seemed to be the most appropriate.

One of the proposed ways of facilitating the evaluation of different solutions is to use the star diagrams that the *MCDM-23* computer program produces. Such a diagram is presented in Figure 1. In this diagram, a larger score indicates better performance. The solar building, illustrated by the lighter area, performs better on all the criteria than the reference building, illustrated by the darker area. It performs relatively much better on resource use, life cycle costs, and environmental loading, but not quite as much better on architectural quality. Thus, this type of illustration can be used to see which design solution scores higher on which criteria.

Table 1: The criteria and sub-criteria used in SHC Task 23

CRITERIA	SUB-CRITERIA
Life cycle cost	Construction cost
	Annual operation cost
	Annual maintenance cost
Resource use	Annual electricity
	Annual fuels
	Annual water
	Construction materials
	Land
Environmental loading	CO_2 emissions from construction
	Annual CO_2 emissions from operation
	SO_2 emissions from construction
	NO_x emission from construction
	Annual NOx emissions from operation
Architectural expression	Identity
	Scale/proportion
	Integrity/coherence
	Integration in urban context
Indoor climate	Air quality
	Lighting quality
	Thermal quality
	Acoustic quality
Functionality	Functionality
	Flexibility
	Maintainability
	Public relations value

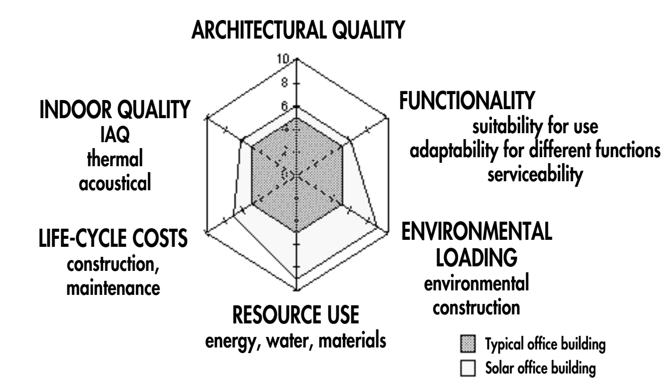


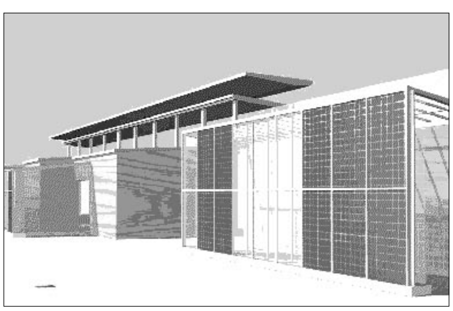
Figure 1: Example of a "footprint" of a solar office building versus that of a typical office building.

Demonstration Buildings

The demonstarion buildings provide an effective way of showing how solar technologies can be integrated in buildings. At the same time they provide an opportunity to test the design tools developed in the Task. At present, one building has been built, a community center in Kolding, Denmark, and several others are planned.

A design objective for the Kolding Community Center was that it should be a sound and ecological building both in construction and in operation. As a result of these reqirements, the building features a comprehensive set of technologies, such as passive solar, daylighting, building integrated photovoltaics, hybrid ventilation, good indoor climate, environmentally friendly materials, limited use of resources, visualization of energy consumption, and reduced water consumption.

The knowledge and tools developed in SHC Task 23 were used during the design of the Community Center. In fact, the designers of all the Task 23 demonstration buildings will use the methods and tools developed in the Task, thereby providing feedback to the process of refining the methods and tools.



View of the partly PV-clad front facade of the Kolding Community Center.

Further Work

In 2002, Task 23 experts will disseminate the results of the work to the building community. The target audiences are designers of low energy and solar buildings that promote sustainable development, as well as the builders, owners, and occupants of such buildings. For architects and engineers results will be shared through workshops, seminars, and design competitions.

For more information contact Anne Grete Hestnes, Task 23 Operating Agent, e-mail: annegrete.hestnes@ark.ntnu.no, fax: +47-73-59-50-45 or visit the SHC website.

Malaysia to Build Low Energy Government Office Building

Model of new Malaysian Ministry for Energy, Communication and Multimedia Low Energy Office building.

The Ministry for Energy, Communication and Multimedia (MECM) plans to capitalize on its move to Putrajaya, the new Federal Administrative Capital of Malaysia, by building a 20,000 m² intelligent Low Energy Office (LEO) building. A goal of this LEO building is to demonstrate how cost effective energy efficiency measures can be integrated into the building design.

To achieve the Ministry's objective, the work of IEA SHC Task 23, *Optimization of Solar Energy Use in Large Buildings*, has been applied through a cooperative effort between Danish consultants and a local Malaysian design team. The energy design team, headed by Poul E. Kristensen of IEN Consultants of Denmark (and an IEA SHC Danish Executive Committee member), won the tender to provide input on the integrated optimization of the building design. And, the Danish Cooperation for Environment and Development (DANCED) provided funding for the energy design input.

This building is significant because it is to demonstrate the technical and economic feasibility of the country's new Building Code—reduce new office building energy from 200-250 kWh/m² year to less than 135 kWh/m² year.

The building design started in January 2001 and was finalized in October 2001 with the launching of a Design and Build tender. The design was developed through a series of design workshops, including study tours to energy efficient buildings in the region.

The first challenge for the design team was to prove to key decision makers that energy efficiency was a worthwhile option for the new Ministry building. To do this, a feasibility study was conducted during the first three months of the project, which resulted in a series of technically feasible and proven energy saving options. The first optimization made, using the computer software Energy-10 and parallel cost calculations, showed that an energy consumption level of around 100 kWh/m² year could be achieved at an extra building cost of less than 10% and that this extra cost could be recuperated through energy savings in less than 10 years.

Based on these calculations, the final go-ahead was given to design the MECM building in May 2001. To optimize the building design an integrated approach was used to ensure that the highest energy savings for the least costs while maintaining optimal indoor climate conditions could be achieved. Again, the Energy-10 software was used extensively. In Figure 1, the final results of the optimization of the MECM building compared to a "typical" new building show a reduction of annual energy consumption from 275 kWh/m² to 100 kWh/m². The calculated extra costs for the energy efficiency features are 8% of the building costs with a discounted payback period of 9 years.

As shown in Figure 2, the use of daylight to offset electric lighting along the perimeter of the building was the first step taken to reduce energy consumption. Then the walls were insulated with 200 mm of aerated concrete compared to the standard 150 mm of brickwork and the roof was insulated with 100 mm of mineral wool in comparison to the norm of 25 mm. This study pointed out that better insulation is not cost-effective due to the relative small temperature difference inside and outside the building (the standard inside design temperature in Malaysia is 23°C).

The largest energy savings were to be achieved through the use of energy efficient lighting and office equipment. The normal design values were 22 W/m² for lighting and 27 W/m² for office equipment. The LEO building is

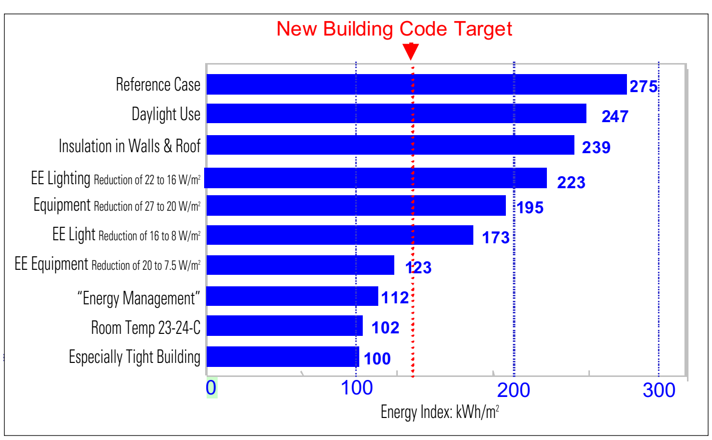


Figure 2. Illustrates how the energy savings from 275 to 100 kWh/m² year were achieved step by step.

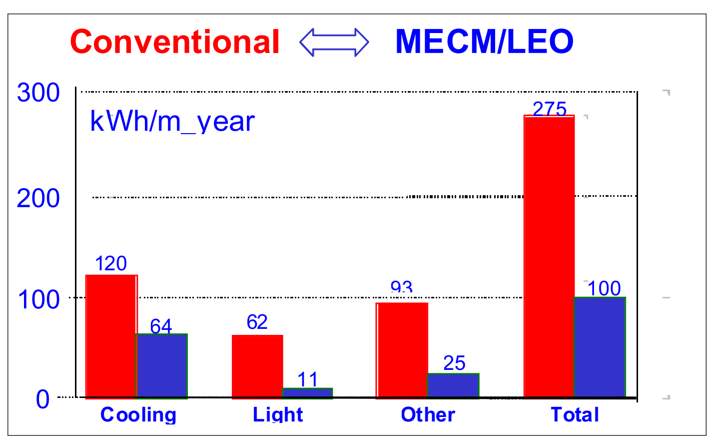


Figure 1. Data of a "typical" new office building compared to that of the LEO building.

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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 which have been developed or conceptualized in a SHC Task and are now being commercially manufactured, marketed or used.

A New Concept is Tested for Solar Combisystems

Integrating solar components into the façade of a building is not a new concept, however, integrating the solar thermal collectors of a solar combisystem is. Mounting the solar collectors on the side of a building instead of on the roof is a promising new opportunity for solar combisystems.

There are several features of façade-integrated collectors which have advantages over roof integrated collectors.

During the summer the angle of a façade-integrated collector helps to avoid overheating the system at stagnation when the collector loop pump is switched, which can occur due to the relatively large collector area needed in combisystems. During the winter, when heat is needed most, the irradiation on the façade at high latitudes is higher than that on a tilted surface. The collector also functions as a passive solar element, even when the collector loop is switched off, and helps to improve the insulation of a building. Due to these reasons, heat losses of the building are minimized. In addition to these contributions, there are the cost savings obtained by replacing the conventional façade with the collector.

Façade collectors are suitable for new buildings and for the renovation of old buildings as well as for homes and larger buildings. By becoming part of a building's architecture, the options for their application improves as some architects and planners are opposed to collectors being tacked on the roof of a building as they detract from the building design.

As part of SHC Task 26, Solar Combisystems, two systems with façade-integrated collectors were measured by the AEE INTEC to evaluate the systems' thermal behavior.

The results of these investigations have been used by two Austrian solar engineering companies for the production of façade collectors.

The test façade of one of the companies is mounted on a two-family home. The collector area is 55 m^2, the space heating storage tank is 3,570 liters with stratifiers and a 500-liter hot water tank. To optimize the overall system a new storage management concept was developed that guarantees the production of hot water outside the heating season without auxiliary energy. The second test façade is mounted on a brick wall of an office building. The collector area is 25 m^2. To measure temperature and humidity, sensors have been placed in the relevant layers of the wall construction. The first results from these tests were very positive. They were presented at a SHC Task 26 Industry Workshop in October 2001 in Switzerland. The proceedings from this workshop and other information on the Task can be found on the SHC Programme's web site, www.iea-shc.org/task 26.✷

Test façade with a 25 m^2 collector on a brick office building in St. Veit, Austria.

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designed for 16 W/m^2 for lighting and 20 W/m^2 for equipment. This reduction in the installed lighting and equipment capacities will have a significant impact, bringing the total energy consumption down to 195 kWh/m^2 year. However, the MECM studies show that the actual installed lighting and equipment capacities can be reduced to 8 W/m^2 and 7.5 W/m^2 respectively, using high efficient lighting and low energy office equipment. This brings the specific energy consumption down to 123 kWh/m^2 year. Combine these savings with energy management steps, such as increasing room temperatures by 1 degree and using "tight building" construction, the predicted energy consumption could be lowered to 100 kWh/m^2year. Beyond this point, other energy saving measures are not considered cost-effective.

During the design process of the MECM building, an Energy-10 seminar with more than 100 participants was held in Kuala Lumpur. The key presentation was given by the SHC Task 23 expert, Dr. Douglas Balcomb of the National Renewable Energy Laboratory in Colorado, United States. The promotion of the MECM design in Malaysia has increased interest in computer design tools to optimise energy efficiency in buildings among architects and engineers.

The tendering phase was complete in December 2001 and the full range of energy efficient measures with an extra cost of less than 10% of the building costs guaranteed. Beginning in 2002 the detailed design and selection of components and systems will be made.

Conclusion

Mr. Kristensen notes that there are many lessons that can be drawn from the integrated design process of the new MECM building. For example, the use of a

IN BRIEF

WORKSHOP ON SOLAR HEAT FOR INDUSTRIAL PROCESSES

8 March 2002 Gleisdorf, Austria

The major share of the energy needed by trade and industrial companies for production processes and for heating production halls is low temperature heat up to 150°C. These temperature levels can be reached using solar energy. To be able to make use of this potential, it is necessary to integrate solar thermal systems into the industrial processes. To examine this more closely a workshop will be held to bring together scientists, consultants and manufacturers with expertise on solar thermal system design, process heat for industrial applications, and marketing solar technologies.

The workshop goals are to show the state of the art of investigations on solar process heat, discuss experiences made with pilot projects, explore the R&D requirements for industrial applications, explore the long-term (>10 years) potential for solar process heat,and discuss the need for international cooperation

The workshop is being organized by by members of the EU funded OPET-Network and by member countries in the SHC Programme (Austria, Germany, Greece, Turkey, Spain and Portugal).

For more information contact Werner Weiss or Thomas Müller, E-mail: w.weiss@aee.at, Fax: +43-3112-5886-18.

TASK 25 AT AIR CONDITIONING TRADE FAIR

14-19 April 2002 Frankfurt, Germany

SHC Task 25, *Solar Assisted Air Conditioning of Buildings*, will be presented at the International Trade Fair AirConTec. AirConTec, an innovative trade fair for the Air Conditioning Industry will be held in Frankfurt, Germany in April 2002. Task 25 and Fachinstitut Gebäude-Klima FGK, the association of German manufacturers of air conditioning equipment, will host a trade booth. The Task 25 component will demonstrate technologies and the potential of solar energy use for air conditioning. The exhibition will include posters on technologies and existing systems, a slide show, a model of a solar desiccant system with an interactive poster (touch-screen), and a computer to demonstrate the design process.

In addition, an industry workshop on solar assisted air-conditioning will be held at the exhibit booth on 17 April from 10 a.m. to 4 p.m.

For further information contact Hans-Martin Henning, Task 25 Operating Agent, e-mail: hansm@ise.fhg.de. Information about the trade fair in general can be found on www.aircontec.de.

TASK 26 INDUSTRY WORKSHOP

SHC Task 26, *Solar Combisystems*, held an Industry Workshop in Rapperswil, Switzerland. This workshop focused on the following aspects of solar combisystems – market and systems, integration of solar collectors, and stagnation and overheating. The proceedings from this workshop and others can be found on the Task 26 page on the SHC website (www.iea-shc.org) ✷

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proven and credible computer software program, such as Energy-10, is a valuable tool in the initial design phase when the case for energy efficiency has to be demonstrated. Due to the software's user-friendly interface, it is expected that Energy-10 will find widespread use in Malaysia among architects and engineers and in universities.

This project also has proven that a new building energy code to reduce the energy consumption in non-domestic buildings by around 50% is feasible. Based on the success of this project's use of SHC Task 23 work, more decision makers, architects and engineers in Malaysia better understand energy efficient measures and the range of options available to achieve a low energy building.

For more information on the MECM LEO building contact Mr. Poul E. Kristensen, Chief Technical Adviser, DANCED, e-mail: poulerik@adr.dk , fax: +45/45/8 55 092.
For more information on SHC Task 23 contact the Operating Agent, Prof. Anne Grete Hestnes, e-mail: annegrete.hestnes@ark.ntnu.no, fax: +47/73/59 50 45.✷

IEA Solar Heating and Cooling 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 21 members of the IEA Solar Heating and Cooling Agreement have initiated a total of 29 R&D projects (known as Tasks) to advance solar technologies for buildings. The overall program is managed by an Executive Committee while the individual Tasks are led by Operating Agents.

Current Tasks and Operating Agents

Task 22: Building Energy Analysis Tools
Mr. Michael Holtz
Architectural Energy Corp.
2540 Frontier Ave.
Boulder, CO 80301 USA
Fax: 1/303-444-4304
E-mail:mholtz@archenergy.com

Task 23: Optimization of Solar Energy Use in Large Buildings
Prof. Anne Grete Hestnes
Faculty of Architecture
Norwegian University of Science and Technology
N-7491 Trondheim, Norway
Fax: 47/73-59-50-45
E-mail: annegrete.hestnes@ark. ntnu. no

Task 24: Active Solar Procurement
Dr. Hans Westling
Promandat AB
Box 224205
S-104 51 Stockholm, Sweden
Fax: 46/8-660-54-82
E-mail:hans.westling@promandat.se

Task 25: SolarAssisted Air Conditioning of Buildings
Dr. Hans-Martin Henning
Fraunhofer Institute for Solar Energy Systems
Oltmannsstrasse 5
D-79100 Freiburg, Germany
Fax: 49/761-4588-132
E-mail:hansm@ise.fhg.de

Task 26: Solar Combisystems
Mr. Werner Weiss
AEE INTEC
Feldgasse 19
A 8200 Gleisdorf, Austria
Fax: 43/3112-5886-18
E-mail:w.weiss@aee.at

Task 27: Performance of Solar Facade Components
Mr. Michael Köhl
Fraunhofer Institute for Solar Energy Systems
Oltmannsstr. 5
D-79 100 Freiburg, Germany
Fax: +49/761 4016681
E-mail:mike@ise.fhg.de

Task 28: Solar Sustainable Housing
Mr. Robert Hastings
Architecture, Energy & Environment GmbH
Kirchstrasse 1
CH-8304 Wallisellen, Switzerland
Fax: +41/1/883-1713
E-mail:robert.hastings@freesurf.ch

Task 29: Solar Crop Drying
Mr. Doug Lorriman
Namirrol Ltd.
38 Morden Neilson Way
Georgetown, Ontario
Canada L7G 5Y8
Fax: +1/905/873 2735
E-mail:dpl@aztec-net.com

Task 31: Daylighting Buildings in the 21st Century
Dr. Nancy Ruck
Department of Agricultural & Design Science
University of Sydney
Sydney NSW 20060
Fax: +61/2/65 544073
E-mail:ncr1@ozemail.com

S☀LAR UPDATE

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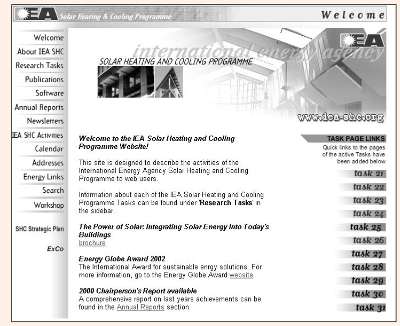
Prepared for the IEA Solar Heating and Cooling Executive Committee
by
Morse Associates, Inc.
1808 Corcoran St., NW
Washington, DC 20009 USA

Editor:
Pamela Murphy



The SHC Website

Visit the SHC website next time you're on the Internet. You will find Programme information, details on Task activities, publications, names of Programme contacts, calendar of upcoming SHC meetings and workshops as well as other useful information.

http://www.iea-shc.org

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Chairman

Mr. Lex Bosselaar
NOVEM b.v.
P.O. Box 8242
3503 RE Utrecht, The Netherlands
Tel: 31/30-239-34-95
Fax: 31/30-231-64-91
E-mail: L. Bosselaar@novem.nl

Executive Secretary

Ms. Pamela Murphy
Morse Associates, Inc.
1808 Corcoran St., NW
Washington, DC 20009 USA
Tel: 1/202-483-2393
Fax: 1/202-265-2248
E-mail: pmurphy@MorseAssociatesInc.com