SOLAR UPDATE

NEWSLETTER OF THE INTERNATIONAL ENERGY AGENCY SOLAR HEATING AND COOLING PROGRAMME • NO. 33 AUGUST 1999

Experts Continue to Assess Building Energy Analysis Tools

Numerous building energy analysis tools are available, but how well they work is not always apparent. To assess the accuracy of software tools for predicting the performance of widely used solar and low-energy concepts, the experts of the Solar Heating and Cooling (SHC) Programme's Task 22, *Building Energy Analysis Tools*, are evaluating and documenting building energy analysis tools.

The Task work is divided into two parts—tool evaluation and model documentation. The tool evaluation activities are based on analytical, comparative and empirical methodologies. The emphasis in this area has been on blind empirical validation using measured data from test rooms or full-scale buildings. The work on documenting existing engineering models is based on the Neutral Model Format (NMF), a standard format for "hard", that is computer readable, model documentation.

The following two articles highlight some of the work of SHC Task 22 experts.

HVAC BESTEST

Test Method for Mechanical Equipment Models in Building Energy Simulation Software

A procedure for testing and diagnosing coding errors, faulty algorithms, and documentation problems in mechanical equipment models used in building energy simulation software is being developed by the U.S. National Renewable Energy Laboratory (NREL), in conjunction with SHC Task 22. The development of this new test method, Building Energy Simulation Test and Diagnostic Method for Mechanical Equipment (HVAC BESTEST), is integral to the improvement of the overall quality of building energy analysis and design tools used for analyzing the cost effectiveness of renewable energy and energy conservation technologies that may be applied in solar buildings. This article describes how HVAC BESTEST evolved and how it is being applied.

A Brief History of BESTEST

Many software programs have been developed to simulate energy performance in buildings. However, the programs—even if considering identical structural designs, energy-related equipment, and energy usage patterns—often produce different results when calculating overall energy performance. Consequently, architects and engineers are reluctant to fully trust these programs, and instead, continue to design buildings without focusing on energy use.

In 1995, to improve the accuracy of energy software and help designers gain confidence in computer predictions, scientists at NREL, in conjunction with the IEA Solar Heating and Cooling Programme and the IEA Energy Conservation in Buildings and Community Systems Programme, completed the Building Energy Simulation Test and Diagnostic Method (BESTEST). This procedure, which focuses primarily on building envelope heat transfer, systematically compares whole-building energy software packages and determines the algorithms, or computer-coded computational routines, responsible for prediction differences.

BESTEST, which was selected as a SHC "must read" publication, has achieved widespread success throughout the world. (See enclosed SHC "must read" list). For example, a number of related test procedures have evolved from the initial work and these procedures are being applied in codes and standards (see sidebar). Also, the list of BESTEST users continues to grow, and several hundred copies of the test procedures have been distributed to energy software developers, energy standard making organizations, researchers, and others concerned with the accuracy of building energy analysis tools.

The most recent expansion of BESTEST is related to testing the ability of simulation software to properly model the performance of mechanical equipment. This new test procedure, HVAC BESTEST, is being written by SHC Task 22 experts from NREL and field tested by experts in several countries participating in the Task. The simulation software currently being used is listed below.

- CLIM2000 (France)
- PROMETHEUS, TRNSYS and analytical solutions*, (Germany)
- DOE-2.1E (Spain)
- Analytical solutions* (Switzerland)
- DOE-2.1E (United States)

**"Analytical solutions" refers to the exact mathematical solutions performed manually outside of a whole-building simulation environment.*

HVAC BESTEST

The energy, comfort, and lighting performance of buildings depends on many

continued on page 2

The Family of BESTEST Procedures

A number of related procedures for comparative testing of building energy simulation software have evolved from the original SHC Programme version of BESTEST. The current family of BESTEST procedures, published by NREL, are:

- **International Energy Agency BESTEST (IEA BESTEST)**. The original SHC Task 12 detailed tests of building envelope heat transfer models, completed in 1995.
- **Home Energy Rating Systems BESTEST (HERS BESTEST)**. Tests building envelope heat transfer models in the context of more simplified software used for Home Energy Rating Systems (HERS) or other code compliance applications, completed in 1995.
- **Florida-HERS BESTEST**. A version of HERS BESTEST for hot and humid climates, completed in 1997.
- **ASHRAE Proposed Standard 140P Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs**. Based on IEA BESTEST, in progress.
- **HVAC BESTEST (IEA BESTEST for Mechanical Equipment)**. The SHC Task 22 detailed tests of thermal models for mechanical equipment, in progress.

Codes and Standards Application Update

The American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE) is adopting IEA BESTEST as a "standard method of test." Public review of this "Standard Method of Test" should occur later this year. Also, ASHRAE is considering using HERS BESTEST as a qualifying tool for performance path software for ASHRAE Standard 90.2 (residential energy efficiency), and the International Code Council is considering its use for the International Energy Conservation Code (IECC), formerly the Model Energy Code.

Building Analysis Tools

continued from page 1

complex thermo-physical interactions. And, computer simulation is the only practical way to bring such a large-scale systems integration problem within the grasp of building designers.

To evaluate these computer simulation tools, the BESTEST technique applies a series of carefully specified test-case buildings and mechanical systems that progress systematically from the extremely simple to the relatively realistic. Output values for the test cases such as, annual energy consumption, loads, system efficiencies, and zone conditions are compared and used with diagnostic logic to pinpoint the routines responsible for prediction differences.

The current set of 30 HVAC BESTEST cases focuses on testing the ability to model mechanical cooling equipment under highly controlled conditions. These cases address basic modeling issues for conventional equipment and related energy conservation features that must be well understood to correctly analyze the amount of conventional energy that can be displaced by passive solar designs versus conventional designs.

About half of the 30 cases are set in the context of a realistic building envelope and realistic climate data. These cases test a program's ability to model equipment performance and occupant comfort as a function of features, such as latent internal gains, infiltration, outside air mixing, thermostat setup, and part loading. Also tested are various economizer control schemes including temperature control, enthalpy control, and compressor lockout.

The remaining cases use highly controlled conditions including a near-adiabatic (highly insulated) building envelope and artificially generated weather data files. This allows performance, which is a function of both outdoor and coil entering conditions, to be tested at a steady state so that analytical solutions for these cases are possible. In these "analytical verification" cases only the following parameters are varied:

- Sensible internal gains
- Latent internal gains
- Zone thermostat setpoint
- Outdoor drybulb temperature.

Variations of these parameters are performed to isolate the effects of the parameters by themselves and in various combinations, as well as the influence of:

- Part-loading of equipment
- Varying sensible heat ratio
- "Dry" coil (no latent load) versus "wet" coil operation
- Operation at typical industry rating conditions.

Helping to Develop Energy Software

BESTEST helps software developers in several ways. Predictions from a building-energy program of interest can be compared to the results from detailed programs already studied, or the algorithm-based differences in predictions observed between several simulation programs can be diagnosed. A previous version of a program can be checked against itself after a programmer has modified the code to ensure that only the intended changes actually resulted. And, the sensitivity of an algorithm to changes may be investigated by checking the modified version against the original.

By itself, HVAC BESTEST is not a complete validation method, as it does not include empirical tests. Instead, it compares a given program with other state-of-the-art programs that have been analytically verified and field-validated with actual buildings. The inclusion of analytical solutions for some of the cases does establish a mathematical truth standard for those particular cases. However, since analytical cases are highly simplified, they are by definition not very realistic. They also often test software outside the typical range of use. Therefore comparative test cases are also needed that are more realistic and thus cannot be solved analytically. Disagreements with the comparative test cases do not necessarily indicate a faulty program, but rather, differences to be studied and understood. In actual field tests, the Task 22 experts have found that disagreements are often attributable to bugs, or faulty algorithms.

So far, the preliminary runs of the diagnostic procedures have resulted in improvements to every one of the building-energy computer programs being tested by the participants. One well-documented example is the CLIM2000 simulation developed by Electricite de France (EDF). Initially, CLIM2000's HVAC BESTEST results showed significant disagreement with other simulation results in a number of areas, which was not unexpected by the software authors since they were in the midst of revising the program before SHC Task 22 began. For their second set of runs, EDF tested the revised CLIM2000's unitary cooling equipment model. These results indicated significant improvement (reduction of previous disagreements) in comparison to other participants' software. However, as a result of using HVAC BESTEST, EDF was still dissatisfied with CLIM2000's inability to account for changes in equipment performance at low part loads (low ratio of load to equipment capacity) and went on to make further improvements. Their third round of results indicated that the latest software changes did improve their model. This example underscores not only the ability of HVAC BESTEST to identify and diagnose problems in mechanical equipment models, but also to check software revisions.

Using HVAC BESTEST

HVAC BESTEST, and the other BESTEST procedures, are designed to help develop reliable building energy analysis software. But the ultimate goal is to assure potential software users that a particular simulation program gives reasonable results or that a program is appropriate for their particular application. HVAC BESTEST will improve building energy analysis software and will increase confidence in their predictions among architects and engineers, enabling them to design increasingly energy-efficient buildings.

For more information contact the Task 22 Subtask Leader: Ron Judkoff, NREL, U.S., Fax: +1 303 384 7540, E-mail: ron_judkoff@nrel.gov; and Joel Neymark, J. Neymark & Associates, U.S., Fax: +1 303 384 9427, E-mail: neymarkj@sni.net.✷

NEXT GENERATION BUILDING SIMULATION TOOLS

Determining the energy and economic performance of solar designs requires evaluation under realistic climatic and operating conditions. Evaluations conducted using computer-based simulations are often more useful than “real-life” experiments, especially during the early, critical stages of the design process. Consequently, computer-based analysis is quickly replacing physical measurements for many problem types in research departments throughout the world. In the building construction industry, computer-based simulation has gained acceptance only in the last few years. However, building designers and manufacturers generally agree that simulation will continue to be more widely used in the building design process. In this situation, it seems natural to think about what the simulation tools and services of the future might look like. Will the predominant tools of today be able to evolve organically and meet future needs? Are the right types of actions receiving funding? This article discusses these issues in the context of SHC Task 22 as well as Task results.

Building Simulation Tools

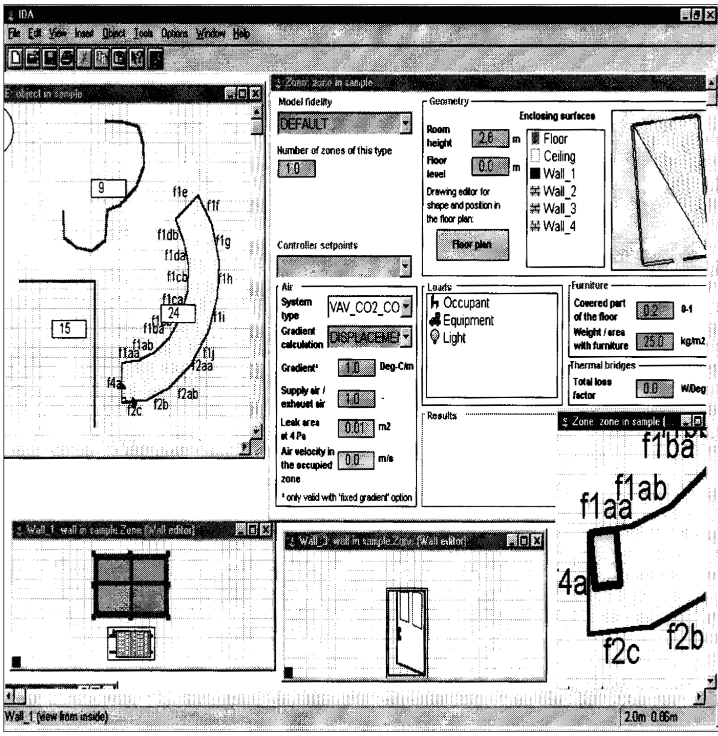
Generally speaking, two different types of simulation tools are used today for building design: *general-purpose* and *special-purpose* tools. A general-purpose simulation program, such as TRNSYS[1], IDA[2] or SPARK[3], treats the mathematical models as input data, thus allowing a user to simulate a wide range of system designs and configurations. Their main advantage is flexibility. Almost anything that lends itself to mathematical modeling can be simulated. Potential drawbacks include difficulty of use, low execution speed, and risk of unexpected program crashes. Special-purpose simulation programs, on the other hand, such as DOE-2[4], ESP-r[5], EnergyPlus[6] or COMIS[7], take advantage of the structure of a class of building simulation problems to reach high execution speed. Consequently, the chief advantages are high execution speed and robustness—low risk the program crashing as long as the input data is reasonable. The major disadvantage of this type of tool is that only the targeted problem class can be considered. It is usually a major undertaking to modify a special-purpose program to suit a non-standard problem type.

In the early years of building simulation, it was natural that only special-purpose simulation tools were widely used because the requirement of simulating the energy performance of a whole building for a complete year could only be met with highly optimized methods. General-purpose simulation programs were, on the other hand, typically used for non-standard problems when performance was less critical, often in academic settings.

When development of general-purpose tools started in earnest in the mid-1980s, expectations for their success were high. Results were expected that would soon make special-purpose tools

1 www.sel.me.wisc.edu/trnsys/
2 www.brisdata.se/
3 www.eren.doe.gov/buildings/tools_directory/software/spark.htm
4 www.eren.doe.gov/buildings/tools_directory/software/doe-2.htm
5 www.strath.ac.uk/Departments/ESRU/esru.html
6 www.eren.doe.gov/buildings/energy_tools/energyplus.htm
7 www-epb.lbl.gov/comis/

continued on page 4



The IDA Indoor Climate and Energy user interface is divided into three levels: Wizard, Standard and Advanced. This illustration shows several of the windows in the Standard level.

Building Analysis Tools

continued from page 3

obsolete. However, as it has turned out, the practical difficulties were greater than anticipated, and it has taken longer to reach satisfactory results than expected. We are nearly there though, as general-purpose tools are capable of handling more and more problem types. Several examples of end-user tools based on general-purpose methods include CLIM 2000[8], CA-SIS[9] and IDA Indoor Climate and Energy[10].

Task 22 Products

IDA Indoor Climate and Energy

In 1995, a consortium of thirty Swedish and Finnish AEC companies was formed to jointly develop a building performance simulation program based on IDA Simulation Environment, a general-purpose tool from the Swedish Institute of Applied Mathematics. Some ten person-years have since been devoted to the development of this new tool, IDA Indoor Climate and Energy[11] (IDA/ICE). In addition to the fact that IDA/ICE is a comprehensive building simulation tool based entirely on general-purpose methods, a number of non-standard physical effects are modeled, such as natural ventilation and vertical temperature gradients. The experts of SHC Task 22 have contributed to the development of this tool by developing most of the mathematical models in a dedicated modeling language, Neutral Model Format (NMF).

One of the most attractive features of general-purpose simulation tools is that one can build successively larger component model libraries, and independent researchers can develop compatible models. If a rich model library is available then the work of building a simulation model for a specific problem is dramatically reduced.

By using NMF, which is a tool-independent modeling language, one can automatically generate a range of tool-specific formats from the same NMF source code. This is important because it enables more model re-use since models can be used in all environments for which translators have been written. (NMF translators have been developed for IDA, TRNSYS, HVACSIM+[12] and MS1[13]; prototypes also have been developed for SPARK and ESACAP[14].)

NMF Models Library

An important product of SHC Task 22 is the NMF Models Library. A key feature of this library is the ability to model airflow as well as thermal problems, which are highly interdependent phenomena. This feature allows users to simultaneously solve the temperature and pressure dependent air flows in doorways and open windows. The library also has component models for primary and secondary HVAC systems. These models are designed to have a minimum number of supplied parameters and include ideal equipment control. For detailed secondary system simulations, the ASHRAE[15] secondary tool kit models have been translated into NMF, and they are compatible with the other models in the library. Models also exist for heating and cooling coils, dampers and valves, to name just a few.

SIMONE

Another product of SHC Task 22 is SIMONE (Simulation Model Network) which is a set of web pages for the NMF libraries. Through a central index page, individual NMF developers are encouraged to publish their NMF work on a local server according to a prescribed format. To lessen the work required to contribute to SIMONE, Task experts have developed tools that will automatically convert a set of NMF source code files into structured web pages.

The Task 22 Models Library and SIMONE can be viewed at the web site <www.brisdata.se/nmf/>.

This article was contributed by Dr. Per Sahlin, Bris Data AB, Sweden, Fax: +46/8-24-45-00, E-mail:, per.sahlin@ brisdata.se, Web site: www.brisdata.se. For more information on Task 22 contact the Operating Agent, Mr. Michael Holtz, Architectural Energy Corporation, U.S. (see page 8 for address).✷

8 www.edf.fr/der/html/produits/publications/cherener.en/art17-en.htm

9 An end-user application by Electricité de France based on TRNSYS

10 www.brisdata.se/ice/

11 www.brisdata.se/ice/

12 www.eren.doe.gov/buildings/tools_directory/software/hvacsim.htm

13 http://www.lorsim.be/

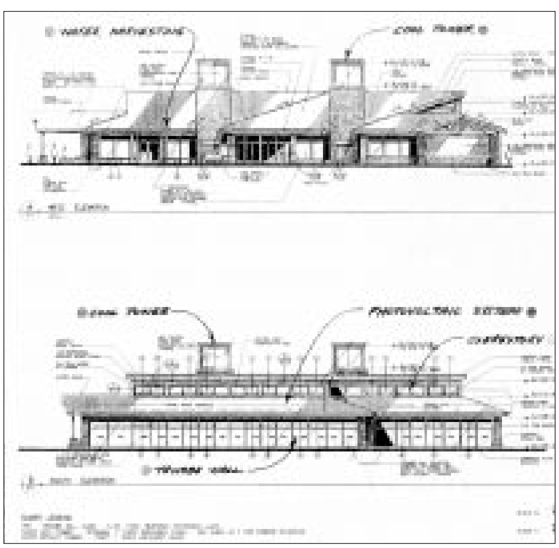
14 http://www.it.dtu.dk/~el/ecs/esacap.htm

15 American Society of Heating, Refrigeration and Air Conditioning Engineers

SOLAR IN BUILDINGS IN THE UNITED STATES

Renewable energy programs in the United States are focused on building and utility applications research, that is, the science and technology required to make solar, biomass, wind, geothermal and hydropower technically feasible and to achieve the cost levels needed to make them competitive in the marketplace. While both utility and building applications are crucial to the United States renewable energy portfolio, this article focuses on the solar building-related activities of the U.S. Department of Energy.

Solar buildings-related activities in the United States continue to evolve and mature. Specifically, passive solar research has moved into a climate-responsive whole buildings/smart design focus, and active solar research is focusing on reliable, low-cost solar hot water systems. In the area of building-focused photovoltaic technologies, research is concentrated on integrated photovoltaic products. The long-term vision of these activities is buildings with energy loads so low that they are able to export energy and also are environmentally sensitive. An integral part of this vision is the application of active solar and building-integrated photovoltaic technologies as well as the use of passive solar/whole building designs.



Cross sections of the Zion National Park Visitor Center.

RESEARCH PROGRAMS

Passive Solar / Whole Buildings

In partnership with the buildings industry, the Department of Energy is making its vision of low energy and environmentally sensitive buildings a reality. The passive solar/whole buildings effort is focused on two inter-related activities, very low energy solar buildings capable of meeting 75% of their heating, cooling and lighting needs using passive solar strategies in combination with building envelope efficiency measures. What this goal translates into are buildings that perform 70% better than ones built to existing standards.

In order to build very low energy solar buildings, easy to use, yet sophisticated, design tools are needed. One example of such a tool is the award winning software, *Designing Low Energy Buildings with ENERGY-10,* that was developed to influence building designs and renovations very early in the design process when critical decisions impacting energy use are made. Attention also needs to be given to mechanisms for evaluating these tools vis-à-vis their capabilities to correctly model the dynamic behavior of passive solar buildings. In this area, the U.S. is leading the IEA Solar Heating and Cooling Programme's work on Building Energy Simulation Test and Diagnostic Method (BESTEST) and the American Society of Heating, Refrigeration and Air Conditioning Engineers' development of a "Standard Method of Test" to evaluate software based on BESTEST. To date, about 30 organizations worldwide have adopted BESTEST.

Research activities on low energy whole buildings are an integral part of the Department of Energy's buildings research program because they are integrating the breakthroughs occurring in component and systems R/D and are showing how whole building design, which incorporates solar, can achieve excellent energy performance.

Active Solar

In the area of active solar, research activities are focused on low-cost solar water heating systems. Current domestic solar water heating systems tend to be marginally competitive with electric water heating. Nevertheless, solar water heating costs must be substantially reduced before significant market demand will occur. The research thrust in this area is to reduce system costs by at least a factor of two. The goal is to achieve a delivered energy cost under $0.04/kWh. As with any system, the cost of the system, its installation, and the distribution and maintenance infrastructure will decrease as volume increases. However, lowering the cost to increase demand of a relatively mature product like a solar hot water heating system is difficult. To address this challenge, researchers are focusing on the development of simple system designs with integral collector-storage (ICS) using polymer technology. ICS systems eliminate the need for a pump and controller, are highly reliable designs, and could radically lower both material and manufacturing costs. Unfortunately, current ICS systems are limited due to problems associated with freeze damage to the supply and return piping.To address the technology's barriers, a competitive solicitation was initiated, and it is the hope that the advances being made, for example in material durability, will lead

NREL's Thermal Test Facility in Golden, Colorado

to the wide use of ICS systems.

Researchers also are working with industry to overcome barriers hindering the incorporation of solar water heating systems into buildings. These collaborative, cost-shared activities are addressing manufacturing problems and building code provisions as well as developing financial and other strategies to encourage potential buyers to purchase active solar systems. Researchers also have collected performance and cost data for use by industry. The goal of these activities is to make solar hot water systems a standard option in new home developments and in utility programs, including green pricing programs. These and similar efforts are integral to the Administration's Million Solar Roofs activities.

Million Solar Roofs is an initiative to install solar energy systems on one million U.S. buildings by 2010. The Department of Energy is working with partners in the building industry, other Federal agencies, utilities, energy service providers, the solar energy industry, financial institutions, state and local governments and non-governmental organizations to remove market barriers to solar energy use and to develop and strengthen demand for solar energy products and applications. This initiative has served as a catalyst for activities from education/awareness programs to the application of photovoltaics (PV) on buildings.

Another Department of Energy initiative that has been undertaken to support solar technologies is PV BONUS. Since the early 1990s the Government has partnered with the photovoltaic industry to develop building-integrated PV products through the PV BONUS initiative. As a result of this effort, PV products, such as photovoltaic shingles, photovoltaic-integrated standing-seam metal roofing, AC photovoltaic modules, large-area modules, and dispatchable photovoltaic peak-shaving systems are available commercially.

SOME RECENT ACCOMPLISHMENTS

Buildings

The solar-buildings related activities of the Department of Energy, in partnership with industry, have lead to the construction of many buildings that perform significantly better than those built to existing standards. Examples include,

■ **The U.S. Department of Energy's Thermal Test Facility at the National Renewable Energy Laboratory**. A whole-building approach was used in the construction of this building in Colorado. The energy features used are natural daylighting, integrated window glazing, engineered overhangs, a good thermal package, evaporative cooling, and a well-engineering automatic building control system. By using natural daylighting the building provides, on average, 52% of its own lighting with daylighting (up to 80% in the summer months) leading to a 63% savings in energy bills.

■ **Grand Canyon House**. The energy performance of this passive solar house in Arizona is 75% better than a typical house in the area. The key features of the building are structural insulated panels, direct gain passive solar heating, trombe wall passive solar heating, an integrated mechanical system which provides exhaust-air heat recovery, and efficient lights and appliances.

■ **Tierra Concrete Homes.** These Colorado homes exceed the standard building performance by 40% and need no cooling even when temperatures exceed 100° Fahrenheit. The solar features used are direct solar gain, thermal storage (concrete walls and floor), overhangs, and natural night ventilation.

■ **Zion National Park Visitors Center.** This building in Utah, now under construction, will use 70% less energy than a comparably-sized building using traditional heating and cooling technologies. The building will have a fanless cooling system and will feature a PV electrical generating system to offset most of the electrical load on sunny days. The building's advanced design already has resulted in construction cost savings of about $1.5 million.

The performance analyses of these buildings and others are providing insight needed to resolve many of the technical issues that are limiting the number of low solar buildings being built in the U.S. The analyses also are providing input for improving the capabilities of design and analysis tools, such as ENERGY-10, DOE 2 and EnergyPlus.

A spin-off from this work on low solar energy buildings is worth noting. A number of national and international retail and fast food chains are applying solar, low energy concepts in some of their buildings. For example, McDonald's has incorporated daylighting in it's T.E.E.M (The Energy Efficient McDonald's) buildings.

Design and Analysis Tools

Two years after its release, *Designing Low Energy Buildings with ENERGY-10* software has approximately 1,050 registered users and over 30 registered "site" users representing architecture and engineering schools and service organizations, such as utilities. And, more than 20 ENERGY-10 workshops, sponsored by the Passive Solar Industries Council and local partners, have been held, with 20

continued on page 7

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

Pre-Fabricated Roof-Integrated Solar Collector

As a result of Task 20, *Solar Energy in Building Renovation*, collaboration between researchers at Chalmers University of Technology and Derome AB in Sweden led to the development and production of a pre-fabricated roof-integrated solar collector. This system not only provides hot water, but also acts as a waterproofing element by serving as the roof membrane. These specially designed modules are mounted directly on the roof trusses. The modules arrive at the building site pre-assembled and need only to be connected to the pipes. The net cost of this collector (collector costs minus the cost of traditional roofing membrane materials) makes this system more competitive with conventionally fueled water or combined water and space heating systems.

United States

continued from page 6

more already scheduled for this calendar year. An upgraded version of this software will soon be released. This new version will include more solar building strategies, including natural ventilation, complex daylighting systems and photovoltaic systems.

Funding

Funding for passive solar/whole buildings research has ranged between $1.35 million and $1.5 million over the past four years. In addition, Small Business Innovation Research grants have allowed industry to carry out research on specific passive solar building system and daylighting concepts. Funding for active solar systems research, during this same four-year time period, has ranged between $2.0 million and $3.6 million, while that for buildings-integrated photovoltaics research has ranged between $1.5 and 3.0 million per year.

For additional information on activities discussed above, please see the National Renewable Energy Laboratory web site: http://www.nrel.gov; the Passive Solar Industries Council site: http://www.psic.org; and the Department of Energy site: http://www.eren.doe.gov.✷

UPCOMING SHC EVENT

Hybrid Thermal / PV Solar Systems Workshop

Due to a growing interest in hybrid PV solar thermal collectors and systems, the SHC Programme, in collaboration with the PVPS Programme, is organizing a workshop on this topic.

A few hybrid PV solar thermal products are now available on the market, but more work is required to further develop this technology. In practice, the combination of two different technologies, although both solar, gives rise to new and sometimes unexpected problems. The objective of this workshop is to review state-of-the-art thermal hybrid systems. Discussions will be limited to hybrid systems which combine a PV and thermal collector into one component. Workshop participants will review the ongoing work in this field and discuss issues such as benefits, technical barriers, potential costs, needed R&D, opportunities and benefits of international collaboration, etc. This workshop will be held 16-17 September 1999 in Amersfoort, the Netherlands.

For more information contact: Lex Bosselaar, Novem, b.v., the Netherlands, Fax: +31 30 231 6491, E-mail: L.Bosselaar@novem.nl. ✷

Thanks To...

Mary-Margaret Jenior who has been involved in the SHC Programme for the past seventeen years, initially in Task 8 and then as the U.S. Executive Committee member. The Executive Committee appreciates Mary-Margaret's dedication to the Programme, in particular her contributions to the development of new Programme work in the area of sustainable buildings. She will be replaced by **Drury Crawley** of the U.S. Department of Energy.

Arne Elmroth who served as the Operating Agent for Task 20, *Solar Energy in Building Renovation.* Arne has the distinction of leading the first Task on the application of solar concepts in building renovation. The Executive Committee appreciates his contributions in this field.

Robert Hastings who served as the Operating Agent for Task 19, *Solar Air Systems*. Robert's contributions to the Programme as an Operating Agent began with Task 11. To the Executive Committee's good fortune, Robert is now acting as the Task Organizer for work in two new areas—solar sustainable housing and solar cities.

Welcome To...

Isaac Pilatowsky, of the Energy Systems Department at the National University of Mexico, will serve as the first Mexican representative on the Executive Committee. To the Committee's pleasure, Mexico joined the SHC Programme this past April.

Bart Poel, of the Dutch company, DAMEN Consultants, will lead the Working Group on Evaluation of Task 13 Houses. Bart previously served as the Dutch expert for Task 13 on Advanced Solar Low-Energy Buildings.

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 20 members of the IEA Solar Heating and Cooling Agreement have initiated a total of 26 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 21: Daylight in Buildings
Mr. Kjeld Johnsen
Danish Building Research Inst.
P.O. Box 119
DK-2970 Hoersholm, Denmark
Fax: 45/42-86-75-35
E-mail: kjj@sbi.dk

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: AECinfo@aol.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
Phone: 46/8-667-80-20
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
Gartengasse 5
A 8200 Gleisdorf, Austria
Fax: 43/3112-5886-18
E-mail:arge-ee-gl@sime.com

Member Countries and Executive Committee Members

Australia	Prof. J. Ballinger
Austria	Prof. G. Faninger
Belgium	Prof. A. De Herde
Canada	Mr. D. McClenahan
Denmark	Mr. J. Windeleff
European Commission	Dr. G. Deschamps
Germany	Dr. V. Lottner
Finland	Dr. P. Lund
France	Mr. Y. Boileau
Italy	Dr. P. Zampetti
Japan	Mr. K. Masuda
Mexico	Dr. I. Pilatowsky
Netherlands	Mr. L. Bosselaar
New Zealand	Mr. M. Donn
Norway	Mr. F. Salvesen
Spain	Mrs. M. L. Delgado
Sweden	Mr. C. Rolén
Switzerland	Mr. U. Wolfer
United Kingdom	Dr. P. Mallaburn
United States	Mr. D. Crawley

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 Kunz
Morse Associates, Inc.
1808 Corcoran St., NW
Washington, DC 20009 USA
Tel: 1/202-483-2393
Fax: 1/202-265-2248
E-mail: pmurphykunz@compuserve.com

The SHC Web Site

Visit the SHC web site 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.

Our Internet address is:

http: / / www.iea-shc.org

SOLAR UPDATE

The Newsletter of the IEA Solar Heating and Cooling Programme

No. 33, August 1999

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 Kunz