SOLAR UPDATE

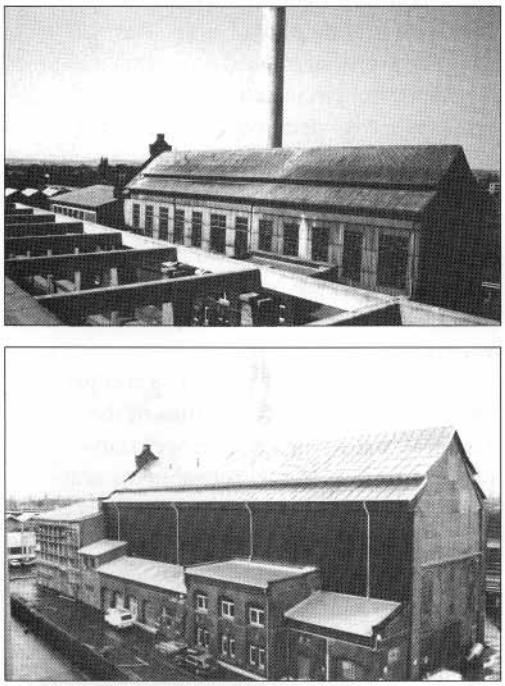
NEWSLETTER OF THE INTERNATIONAL ENERGY AGENCY SOLAR HEATING AND COOLING PROGRAMME • NO. 21 MAY 1993

Task 14 Solar Air Systems Work Attracting Interest Worldwide

One of the benefits of the IEA is the acceleration of the pace of development and commercializa tion of new technologies, and this has been particularly evident in the Air Systems Working Group of Task 14 on Advanced Active Solar Systems. The Group has focussed its efforts on a new perforated Solarwall® solar absorber which promises to be 35-40% more cost-effective than conventional solar air collectors for low-temperature heating applications. Several demonstration projects are underway within the Task including ventilation air heating for industrial buildings in Canada and the United States, heating of combustion air for a gas cogeneration facility in Germany, and crop drying in Southeast Asia.

The innovative idea for the perforated absorber, patented by Canadian engineer John Hollick of Conserval Engineering and Swiss scientist Rolf Peter, came about as a direct result of bringing experts and industry representatives from various countries together at an IEA workshop on solar air systems in the Netherlands in 1988. Since then, the idea has sparked $1 million in solar heating installations in Canada, U.S. and Germany, including major industry clients Ford, General Motors and Bombardier.

The special absorber has also generated over $400K in research activity at laboratories around the world. Much of this work is being spearheaded by members of Task 14's Air Systems Working Group.



Before and after views of the Solarwall® installation at the Alcan Plant in Gottingen, Germany. In addition to the energy savings, the panels enhanced the appearance of this industrial building.

First Project Constructed in Europe

Following an agreement between Conserval Engineering and Alcan of Germany, the first perforated Solarwall® to be built in Europe has been constructed in Gottingen, Germany, home to one of Alcan's most modern painted sheet plants.

The Solarwall® at the Alcan Plant, designed to preheat the combustion air used by the boilers in an existing gasfired cogeneration plant operated by the local utility, is expected to increase the boiler efficiency by 1-1.5%, providing annual energy savings of 130 MWh. The design of the German installation was based on information from Canada's National Solar Test Facility as well as the field demonstrations with Ford and GM. The project partners include the Gottingen utility, the German Institute for Solar Energy Research (ISFH) and the University of Stuttgart.

New Application for Crop Drying

At a recent Task 14 meeting, discussion centered on the use of the perforated absorber for crop drying in southeast Asia. Potential applications for the new absorber including cocoa drying in Malaysia, drying of tea leaves in Indonesia, and the drying of bananas in Thailand. Dr. Noh Dalimin from Malaysia, who presented the cocoa drying application, explained that Malaysia is the third largest exporter of cocoa in the world, and there is a year-round demand for bean drying.

Doug McClenahan, Chairman of the Air Systems Working Group, presented the results of a feasibility study by Enermodal Engineering concluding that the perforated absorber was the most cost-effective solar collector design for drying applications requiring temperature rises of as much as 25-30°C.

The crop drying projects are part of a $5 million ASEAN-Canada project on solar energy for drying processes being funded by the Canadian International Development Agency (CIDA). The objective is to develop solar crop drying pilot plants with wide-spread regional application and commercialization potential. Construction of the projects is scheduled to begin in June of this year, and they will be fully monitored.

Alcan to Develop New Coatings

The activity of Task 14 participants has also helped to generate interest at Alcan International Limited's Research and Development Centre in Canada where a project has begun to develop improved coatings to enhance the performance and market appeal of the perforated absorber. This is the first time Alcan has shown interest in the solar product area since the early 1980's. Alcan has substantial experience in coatings technology, and their approach will be to identify formulation

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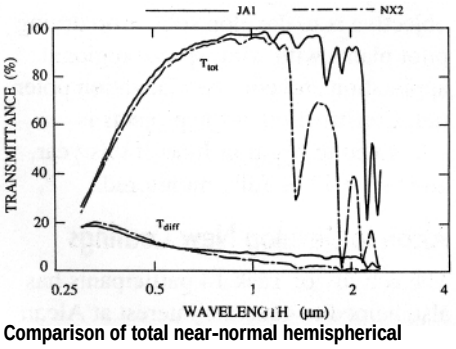
Task 18 Advanced Glazing Projects Underway on All Fronts

Task 18 (Advanced Glazing Materials) is now one year into its research phase and work is in progress on many of the Task's nineteen projects. With participation from fifteen countries and more than sixty individuals actively involved in the research, the work represents the largest of the current IEA SHC Tasks. Although the activity is still at an early stage, considerable progress has been made in many areas.

Applications Assessment

It is well known that advanced glazing materials promise to yield significant energy and environmental benefits in buildings. But less is known about the best glazing materials for particular applications, what control strategies should be adopted, and what effect will climate have on particular applications. Subtask A of Task 18 focuses specifically on these issues.

Energy benefits can be predicted with the use of building energy analysis tools. Participants are currently reviewing the input parameters of major simulation tools and carrying out a critical appraisal of these parameters with the data presently held and parameters that



Comparison of total near-normal hemispherical transmittance, Ttot, and the diffuse component, Tar, for Japanese and Norwegian aerogel samples.

are being measured in the testing projects. This concentration on modelling activities should allow more accurate predictions of energy benefits, identification of appropriate applications and selection of the best glazing systems to meet particular needs.

Such studies, coupled with market potential studies, will allow refined predictions of benefits to be made against future timescales. These results will be of immense value to industry in product development for specific market needs.

Full-Scale Window Assessment

Measurement of key glazing performance parameters and the development of reliable test procedures are primary objectives of several of the Task's testing projects.

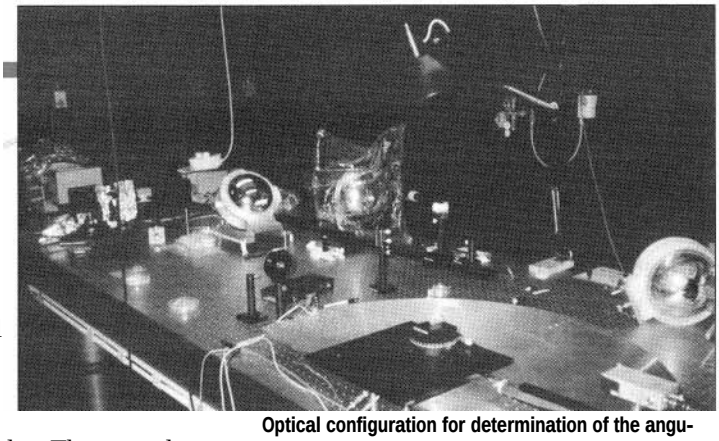
Two major international glass companies have agreed to manufacture test windows for the participants. Argonfilled double-glazed low-emittance windows have been constructed by Pilkington Glass Ltd, UK, and distributed to laboratories in 13 countries. Windows of dimensions up to 1.2 x 1.2 m2 have been customized to meet the testing needs of individual laboratories.

Interpane, the German glass company, has prepared double-glazed units which include a highly-absorbing solar control glass for distribution to the same participants. The laboratories will measure total energy transmittance, U-value and the spectral directional optical properties.

The testing programme is coordinated by Dr Werner Platzer of the Fraunhofer Institute for Solar Energy Systems, Freiburg. To support the testing work, the Netherlands has produced a report reviewing and detailing all relevant international standards for measurement of glazing performance parameters at solar and thermal wavelengths.

Evacuated Glazings Prototypes

Professor Dick Collins of the University of Sydney, Australia, leads the Task 18 project in evacuated glazings. Significant progress has been made in advancing the concept of evacuated glazing towards real products. Plans are in hand for the distribution of 1 x 1 m2 prototypes to the testing laboratories for measurement of performance. The project participants are preparing an updated state-of-the-art review and defining test methods for the evaluation of windows.



Optical configuration for determination of the angularly resolved scattering of aerogel materials (Uppsala University, Sweden).

Simulation studies will be combined with laboratory tests to determine mechanical stresses and assess fracture probabilities. The evacuated glazing project promises to provide a true evaluation of the potential for use of this form of window for high performance insulating systems.

Optical Properties of Aerogels

Aerogels have attracted widescale interest as potential materials for inclusion in highly-insulating glazing units. Aerogel samples prepared in Norway, Japan and Sweden were circulated to a number of laboratories for detailed spectral measurements at ultraviolet, visible and near infrared wavelengths. Measurements were made of total and diffuse spectral transmittance and reflectance. Angular resolved scattering properties were also determined in Sweden by Uppsala University.

The figure at left presents a comparison of transmittance properties of the Japanese and Norwegian aerogel samples. Such measurements enable the scattering characteristics of these materials to be understood and allow the generation of performance curves for use with simulation tools which predict the optical and thermal performance of highly scattering transparent media.

For more information on Task 18 contact the Operating Agent, Prof. M.G. Hutchins. (Seepage 8 for address).

SPECTRAL RADIATION DATA

Narrow-Band Spectral Radiation Data Acquisition, Analysis and Modelling
S. Nann and A. Bakenfelder, eds., January 1993, 39 pp.

This Task 17 report deals with measuring and modelling spectral solar radiation on the earth's surface within the wavelength interval of 300 - 4000 nm. The report is divided into four parts:

- Information on the natural variability of measured solar spectral radiation
- Recommendations, based on Task 17 experience, on how to achieve high quality measurements and data acquisition
- Documentation of the most comprehensive data base of solar spectral irradiance measurements (compiled by ZSW, Germany)
- Recommended spectral irradiance models and their basic features.

The report may be ordered from: Deutscher Wetterdienst, Meteorologisches Observatorium Hamburg, Frahmredder 95, D-2000 Hamburg 65, Germany.

METEOROLOGICAL INSTRUMENT ACCURACY

IEA Comparison of Longwave Radiometers
K. Dehne, U. Bergholter, F. Kasten, March 1993.

During the past few years, the uncertainties of solar radiation measurement techniques have been reduced to ±1 %, in large part because of the activities of IEA SHC Task 9 (Solar Radiation and Pyranometry Studies). On the other hand, the current accuracy of measuring terrestrial radiation, also called infrared, thermal or longwave radiation, is far from satisfactory, with a measurement uncertainty of ±10%.

To address this problem, a Task 9 comparison of longwave radiation measurement procedures was performed at the Meteorological Observatory of Hamburg, with six IEA countries participating with eight measuring systems. The purpose was to assess the state-of-the-art of measuring techniques and instruments, to analyze the calibration techniques used, and to recommend improvements in measurement and calibration techniques.

The comparison exercise confirmed the uncertainty levels of ±10% and identified the main sources of differences in the measured values as the differences in the calibration and correction factors of the instruments. This implies the need for a substantial effort to improve and standardize the calibration techniques for longwave radiometers. As an interim step, several practical techniques are identified and recommended for reducing measuring errors, such as ventilation and shading of various parts of the instruments.

The report may be ordered from: Deutcher Wetterdienst, Meteorologisches Observatorium Hamburg, Frahmredder 95, D-2000 Hamburg 65, Germany.

COLLECTOR PERFORMANCE CHARACTERIZATION

Characterization and Testing of Solar Collector Thermal Performance
S.J. Harrison et al, March 1993.

This report describes the work performed in Task 3 on the characterization and testing of the thermal performance of low-temperature solar collectors. The collector types covered include unglazed collectors, evacuated tubular collectors, heat pipe and boiling/condensing collectors as well as conventional flat-plate collectors.

For each of these collector types, simple models have been developed to describe the sensitivities of the thermal performance of the collector to operating conditions. Among the variable considered are irradiance levels and ambient temperature, heat transfer fluid flow rates, thermal radiation, wind-induced convection losses, and leakage from air collectors. The models form the basis both for performance testing and for predicting the performance in operation from the test results.

The report may be ordered from: Dr. S.J. Harrison, Solar Calorimetry Lab., Dept of Mechanical Engineering, Queen's University, Kingston, Ontario, Canada K7L 3N6.

MODELING TRANSPARENT INSULATION MATERIALS

Transparent Insulation Material Modeling
H. Erhorn and R. Stricker, September 1992, 50 pp + appendices.

This documents presents work conducted as part of the High Performance Glazing activity of Task 12 - Building Energy Analysis and Design Tools for Solar Applications.

The purpose of this activity was to develop algorithms that could be incorporated into an annual building energy simulation tool for predicting the thermal and optical performance of transparent insulation materials (TIM). This report reviews various types of TIM, their properties, applications and construction techniques, followed by a description of methods for modelling such systems in buildings.

Examples of the algorithms are included, which correct some of the shortcomings in currently-used techniques. Used in a variety of building energy analysis programs, they allow the impact of transparent insulation systems on the energy and daylighting performance of a building to be predicted. *The report may be ordered from: Hans Erhorn, Fraunhofer Institut fiir Bauphysik, Nobelstr. 12, D-7000 Stuttgart 80, Germany.*

Task 14 from page 1

improvements which will make an immediate impact on the product's capability and appeal. Preliminary results of this work will be presented at the next Task 14 meeting.

For more information, contact: Doug McClenahan, Energy Mines and Resources, CANMET/EAETB, 580 Booth St., Ottawa, Ontario, Canada K1A OE4. Fax: 1-613-996 9416.

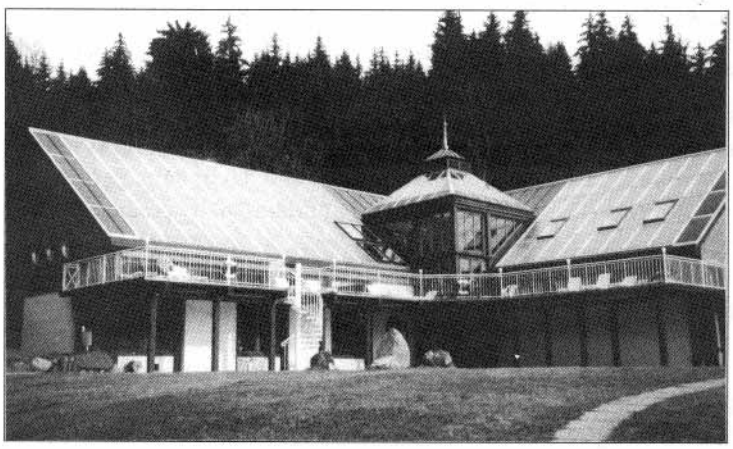
Austria Succeeds in Increasing Share of Renewables in Energy Mix

The contribution of renewable energy sources to end-use energy consumption in Austria has increased remarkably in recent years to about one-third of the total. Moreover, the size of the domestic market for solar collectors in 1992 placed Austria in the top ranks of the international solar market. These facts indicate that the government and people of Austria are serious about their determination to protect the environment and reduce the use of imported fossil fuels.

Energy Policy

These goals are reflected in the 1993 Energy Report of the Austrian government, currently in preparation, which stresses the considerable efforts the Government is undertaking to develop an environmentally-acceptable energy strategy. One highlight is the commitment to reduce carbon dioxide emissions by 20% by the year 2005. The Energy Report, which forms the basis for the government's energy policy, also emphasizes reduction of energy imports (currently 60% of net primary energy) and of dependence on liquid hydrocarbons.

At present, 67 % of Austria's energy demand is covered by non-renewable (fossil) energy sources. The remaining 33% is supplied by renewable energy sources, a little more than half of which is from hydro- power and the remainder from "other" renewable energy sources such as biomass and solar.



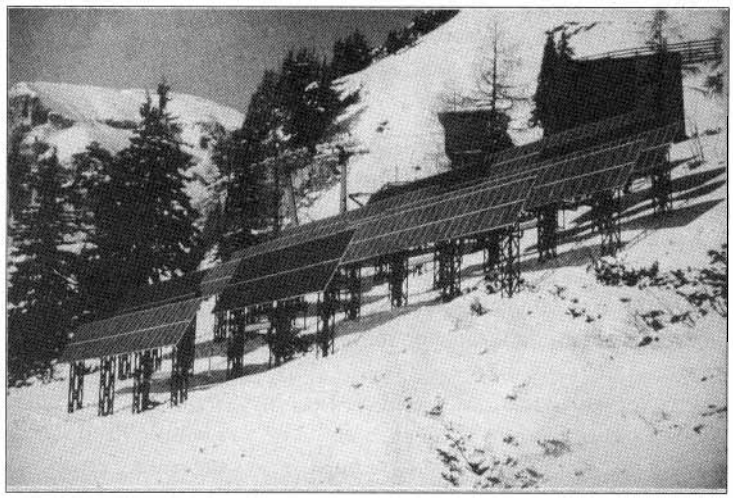
Solar installation in Austrian hotel.

Program Organization

The Federal Ministry for Science and Research is responsible for the coordination of Austria's energy research, development and demonstra- tion (RD&D) program at the national level. National energy policy matters are the responsibility of the Federal Ministry for Economic Affairs. The Provinces also have responsibility for certain ener gy matters.

To achieve the energy policy goals, major efforts have been initiated in ener- gy conservation, new and environ- mentally-benign energy sources and renewable energy technologies. Great emphasis is placed on the development of fluidized bed combustion technology and research on the nature and reduction of emis- sions of airborne pollutants from industry, traffic and combustion of biomass.

Numerous projects are carried out by industry, partly in cooperation with universities and other research institutes, sponsored by the Promotion Fund for Commercial Research, which is mainly inanced by public funds. The industry restricts its involvement to technologies which promise near-term commercializa tion. Examples of product development carried out by government/industry collaborative programs are heat pump and solar energy systems, plus biomass technologies.



A 30 We grid-connected PV power plant in the Alps.

Funding

The RD&D expenditures for renewable energy technologies were about 48 M AS, or 23% of the total energy budget of 211 M AS in 1992. Within the field of solar energy, the 1992 budget included 4.8 M AS for passive systems, 3.0 for active solar systems and 14.3 for photovoltaics. About 80 % of the government's expenditures in solar energy have been used for projects within the IEA Solar Heating and Cooling Programme. In addition, 1.4M AS went to wind energy, and 24 M to Biofuels.

R & D Emphasis

Austrian RD&D efforts have concentrated on:

- Developing economical and efficient collectors and solar systems for swimming pool and domestic water heating with a lifetime of more than ten years
- Studying space heating systems using collectors or heat pumps
- Compilation, improvement and expansion of the meteorological data base for Austria
- Development of passive solar components and systems consistent with Austria's climatic conditions.
- Establishment of test stations for

the evaluation of solar systems, heat pump and photovoltaic systems performance.

• Demonstration projects, especially in public buildings.

In 1992, solar systems were installed in a number of hotels, sponsored by special funds. (See photo on page 4 for one example.)

Government Incentives

Solar systems qualify for tax advantages in Austria when they are used under conditions specified by the national energy policy. Provincial governments also support renewable energy technologies on the market by funding about 20-30% of the investment costs.

Information Activities

In addition to reliability, cost-effectiveness, and mass production of parts and components, better information on new and renewable sources of energy is considered essential to the adoption of these technologies. Appropriate educational materials have been prepared in recent years in order to provide information to all interested parties and to promote the use of solar systems.

Since the introduction of new technologies requires trained manpower, seminars are held at regular intervals on the planning, design and operation of solar systems. Between 1977 and 1992 more than 600 of these seminars were held in Austria.

Solar System Market Penetration

The domestic market for solar systems was about 140,000 m' in 1992, which places Austria in the top ranks of the international solar market. In 1992 about 41 % of 140,000 m' of collectors installed was used for swimming pool heating. The number of solar systems for hot water preparation, especially residential systems, has been rising mainly due to the successful work of organized "do-it-yourself" groups.

At present, the total area of installed collectors is approximately 725,000 m^2, 41 % for swimming pool heating and 58% for hot water preparation. The annual heating output of solar technology is approximately 240 GWh, which corresponds to an annual savings of about 64,000 tons of oil.

The photovoltaic systems market is still in its infancy. Currently PV systems are used for communication and warning systems and also for small grid-connected residential systems. About 200 kWe roof-integrated photovoltaics systems (1 - 3.7 kWe) have been subsidized by the government and the utilities (at about 60% of the investment costs). At the end of 1992, photovoltaic systems with a total power of about 350 kWe were in operation. A 30 kWe grid- connected PV power plant in the Alps is pictured on the previous page.'

IEA Task 16 Demosite Launched in Lausanne

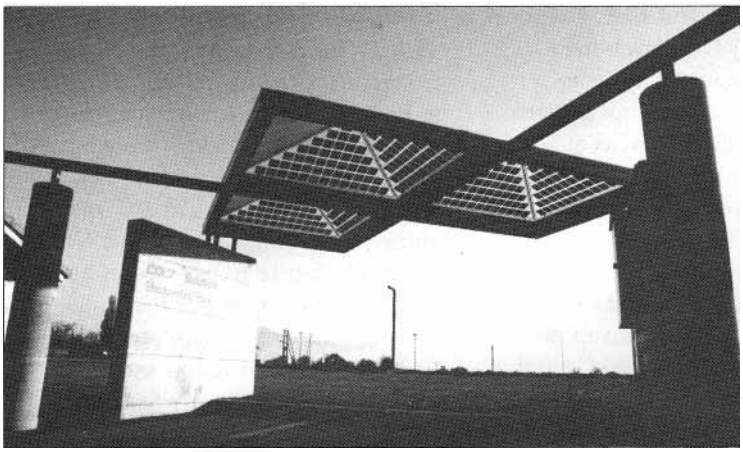
The new IEA Demosite for Photovoltaic Building Elements promises to be a major highlight of Task 16 (Photovoltaics in Buildings). The international test and demonstration center, located at the Swiss Federal Institute of Technology in Lausanne (EPFL), has been operational for several months. Financial support is provided by the Swiss Federal Office of Energy and the EPFL.

The Demosite serves as a test facility as well as an exhibition of the architectural integration of photovoltaics components into the building structure. At present eight pavilions are equipped with different kinds of PV modules to test their performance in roofs and building facades and evaluate various integration techniques.

Measurements of system performance and meteorological data will be taken by the Solar Energy and Building Physics Laboratory at EPFL, a neutral organization.

Thus far, companies from Switzerland, France and the U.S. are testing hardware and architectural integration techniques at this facility; others are invited to join.

For more information, contact Ecole Polytechnique de Lausanne, Dept. of Architecture, LESO-PB, CH-1015 Lausanne, Switzerland. Fax: 41-21-693 2722.



View of PV test installations at the Task 16 Demosite in Lausanne.

SPOTLIGHT ON...

Prof. Gerhard Faninger

Representative from Austria

I knew that I had seen Gerhard Faninger around the table at Executive Committee meetings for as far back as I could remember. But to my surprise I learned that he has, in fact, been Austria's representative since the first Executive Committee meeting in 1977, thirty-three meetings ago. As the senior member of the Committee he has provided important continuity and support to the program.

Born in the charming Austrian city of Klagenfurt, Prof. Faninger received his first degree in metallurgy, followed by his doctoral degree in solid state physics, both from the University of Mining and Metallurgy in Leoben.

Between 1961 and 1972, he taught physics and x-ray structure analysis at the University in Leoben and conducted basic research on metal physics, beginning as an assistant and ending as full professor. Then came a three-year position as head of the Institute for Material Research and Technology at the Battelle Institute in Frankfurt, Germany.

Prof. Faninger's solar energy career began in 1976 when he was appointed head of the Solar Energy Department at the Austrian Solar and Space Agency in Vienna. He is now responsible for coordinating all renewable energy research in Austria for the Ministry for Science and Research.

In addition, since 1986 he has been in charge of renewable energy technologies at the Austrian Research Center in Seibersdorf. He also lectures in renewable energy technologies at the University of Technology at Vienna and is involved with the University of Klagenfurt's post- graduate studies program on energy and the environment.

Since 1982, he has organized four International Summer Schools in Solar Energy, which provide both theoretical courses and hands-on experience for post-graduate students and researchers. As the "founding father" of the international summer school concept, he has worked very hard to ensure its success. In recent years, he has brought quite a few students from Eastern Europe to the summer school. He has a strong interest in resolving the energy problems of that region and in involving institutes from the former eastern bloc in European and international research activities.

When asked to comment on the IEA SHC Program, Prof. Faninger calls it a "locomotive" for his work. And he finds the Executive Committee to be "a real family."

Dr. Faninger and his wife have two children. Their youngest, Bernd, is finishing his last year in high school. Their daughter Heidrun is a medical doctor who is now a Finnish citizen as a result of her marriage to Peter Lund, the representative from Finland to the ExCo! She and Peter have produced the Faningers' first grandchild, who has the quintessental Austrian name of Maria Teresa, but is better known to her family as "Tessie."

NEWS IN BRIEF

New Members

Welcome to France and Turkey which are new signatories to the IEA SCH Implementing Agreement. Also, New Zealand recently re-activated its membership. We are pleased to have all three countries in the collaboration.

Links with the Energy Conservation Agreement

A joint meeting of the IEA SHC ExCo and the IEA Energy Conservation in Buildings and Community Systems (BCS) ExCo will take place in Germany in October 1993 to discuss areas of common interest and enhance collaboration between the two agreements.

Task 15

At its October 1992 meeting, the Executive Committee decided to convert the proposed Task 15 on Advanced Central Solar Heating Plants with Seasonal Stor age into a a working group, at least for the time being. The working group format permits continued information exchange, as well as preparation of a guidebook and seminar for decision-makers. If a sufficient number of countries decide to construct new plants, the ExCo will consider a formal task once again.

Slovenian Participation

Task 18 has responded to the Executive Committee's call for extending contacts to Eastern Europe. Representatives of the Boris Kidric Institute of Chemistry in Slovenia who are active in research on electrochromic devices and other glazing technology attended the November 1992 Task 18 Experts' Meeting. An application for Associate Participant status is expected to be presented to the Executive Committee for approval.

IEA Button Goes to the White House

On January 21, Solar Update editor, Sheila Blum, attended a reception at the White House where she met the newly-inaugurated President Clinton and Vice-President Gore. To demonstrate support for solar energy, she wore her IEA button.

Unexpected letter to the Editor

The editor receives quite a few letters expressing interest in Solar Update, but by far the most surprising and touching was a letter which arrived a few months ago from the Iraqi Refugee Camp in Saudi Arabia. Somehow a copy of the newsletter had reached a young physicist living in the camp. Hopefully he and his family are now resettled in a better place and finding life a little easier.

Improved Accuracy of Analysis Tools is Aim of Model Evaluation Activity

In the last issue of Solar Update, we reported on the model development activities of Task 12 (Building Energy Analysis and Design Tools). This article deals with the task's model evaluation activities.

Little objective information has been available to assist designers in selecting the most appropriate and accurate design tools for their particular purpose. Obviously, vendors of software have little incentive to reveal limitations, simplifications, or inaccuracies, or may not even be aware of them.

To address this problem, Task 12 researchers have undertaken several activities aimed at assessing the accuracy and capability of building energy analysis tools in predicting the performance of solar heating, cooling and daylighting materials, components and systems.

Three Validation Methods

Three types of validation approaches can be utilized to evaluate the accuracy of building energy simulation programs, each having different strengths and weaknesses:

- Analytical Verification - Mathematically-known solutions for easily-calculated heat transfer phenomena (e.g., heat conduction through walls and shading effects) are compared to results obtained by simulation programs. However, closed-form solutions cannot be used to calculate the interactive effects between more than one heat transfer mechanism-between conduction and convection, for example.
- Comparative Testing - Carefully-specified test cases are created which are analyzed by detailed, "state-of-the-art" public domain models. The range of results from these programs can be used as benchmarks to compare the performance of other computer programs.
- Empirical Validation - Simulation results are compared to measured data from a monitored building. The drawbacks of this method are the high cost of instrumentation and monitoring and the large amount of data required to understand if a tool can handle a wide range of conditions.

Task 12 has been involved with each of these validation methods.

Analytical Verification

In the analytical verification area, a compendium of known analytical solutions has been prepared. The intent is to organize and edit these analytical solutions into a useful manual that code authors/developers can use to evaluate basic heat transfer modeling features into their simulations.

Comparative Evaluation

The BESTEST (Building Energy Simulation Test) specifications, which describe a set of residential building test cases for evaluating and diagnosing building energy analysis and design tools for software-to-software comparisons, have been finalized. Applying these test cases, Task 12 researchers from six countries have completed a final round of computer simulations using national detailed building energy analysis tools. Criteria have been established for setting the ranges that will be used for each of the BESTEST cases. A final report of BESTEST specifications and results are now being prepared.

When the "acceptable range" has been established for each of the test cases, based on the calculations of the detailed energy analysis tools, the results can be used to determine the accuracy and capabilities of other building energy analysis tools.

In addition, a preliminary set of multi-zone specifications for commercial buildings has been prepared, and a first round of computer simulations has been completed. Considerable work remains to establish a reasonable set of commercial building design conditions-issues related to envelope, lighting systems, HVAC systems, schedules, and so on. Also, only a few national building energy analysis simulations are presently capable of modeling the full complexity of a commercial building.

Empirical Validation

A joint IEA working group* on building energy analysis tool evaluation has recently completed the largest "blind" empirical validation exercise ever undertaken. Prediction of total heating energy consumption and maximum and minimum temperatures, made by 24 developers and users of 15 different programs, have been compared with the data measured in simple single-zone test rooms. The program users and developers were given a detailed description of the test rooms, located in Bedfordshire, England, and weather data for a portion of the monitored period.

Considerable effort was made by the exercise coordinator, De Montfort University, Leicester, England, to minimize errors in the documentation and data supplied to the program users. Also, sensitivity analyses were undertaken to estimate the total "error band" due to the uncertainties in both the measurements and the room descriptions. Nevertheless, despite the simplicity of the test buildings, the heating energy consumption predictions of the programs varied by 50% and the peak temperature predictions varied by up to 11 °C.

These results suggest that errors, model limitations or inappropriate approximations exist within many detailed thermal simulation programs, and that these problems impair the ability of the programs to adequately model buildings. Clearly a need exists for further validation work to improve the accuracy of these programs.

In response to the need for improved simulation tools, the joint working group has developed an error diagnostics procedure based on inter-model comparison that can be used for this purpose. This procedure will help pinpoint the weaknesses in the various programs and permit problem algorithms to be corrected.

* lEA Solar Heating and Cooling Task 12 and IEA Energy Conservation in Buildings and Community Systems Annex 21

*For further information, contact: Michael Holtz (Task 12 Operating Agent), Architectural Energy Corp., 2540 Frontier Ave, Boulder, CO 80301, USA. Fax: 1-303-444-4304. **

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 including collaborative research, development and demonstration projects in new energy technologies. The 20 members of the IEA Solar Heating and Cooling Agreement have established a total of 20 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 12: Building Energy Analysis Tools for Solar Applications
Mr. Michael Holtz
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Task 13: Advanced Solar Low Energy Buildings
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Task 14: Advanced Active Solar Systems Mr.
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Task 16: Photovoltaics for Buildings Dr.
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Task 17: Measuring and Modeling Spectral Radiation
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Task 19: Solar Air Systems
Mr. Robert Hastings
Forschungstelle Solararchitektur
ETH Honggerberg
CH-8093 Zurich, Switzerland
Fax: 41/1-371-5548

Task 20: Solar Retrofit
Prof. Arne Elmroth
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SOLAR UPDATE

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