IEA SHC Annual Report 1996

Table of Contents

Building Energy Analysis Tools

Working Group

Materials in Solar Thermal Collectors

Address List

PREVIOUS — CONTENTS — NEXT

IEA Implementing Agreement

BACKGROUND

The International Energy Agency (IEA) was founded in November 1974 as an autonomous body within the framework of the Organization for Economic Cooperation and Development (OECD) to carry out a comprehensive program of energy cooperation among its 23 member countries. The European Commission also participates in the work of the IEA.

The IEA's policy goals of energy security, diversity within the energy sector, and environmental sustainability are addressed in part through a program of international collaboration in the research, development and demonstration of new energy technologies, under the framework of over 40 Implementing Agreements.

The Solar Heating and Cooling Implementing Agreement was one of the first collaborative R&D programs to be established within the IEA, and, since 1977, its participants have been conducting a variety of joint projects in active solar, passive solar and photovoltaic technologies, primarily for building applications. The overall Programme is monitored by an Executive Committee consisting of one representative from each of the 20 member countries and the European Commission. The members are:

Australia
Austria
Belgium
Canada
Denmark
European Commission
Germany
Greece
Finland
France
Italy
Japan
Netherlands
New Zealand
Norway
Spain
Sweden
Switzerland
Turkey
United Kingdom
United States

CURRENT TASKS

A total of twenty-one Tasks (projects) have been undertaken since the beginning of the Solar Heating and Cooling Programme. The leadership and management of the individual Tasks are the responsibility of Operating Agents. The Tasks which were active in 1996 and their respective Operating Agents are:

Task 13	Advanced Solar Low Energy Buildings	Norway

Task 14	Advanced Active Solar Energy Systems	Canada
Task 16	Photovoltaics in Buildings	Germany
Task 18	Advanced Glazing and Associated Materials for Solar and Building Applications	United Kingdom
Task 19	Solar Air Systems	Switzerland
Task 20	Solar Energy in Building Renovation	Sweden
Task 21	Daylight in Buildings	Denmark
Task 22	Building Energy Analysis Tools	United States

PREVIOUS CONTENTS NEXT

Chairman's Report

Prof. André De Herde
Université Catholique de Louvain
Belgium

INTRODUCTION

As the new chairman, it is with great pleasure that I recognize the 20 years of work conducted under the IEA Solar Heating and Cooling (SHC) Programme. During 1976-1977 Programme participants identified specific projects in key solar energy areas, which served as the starting point for two decades of international collaborative research in the areas of solar materials, advanced glazing materials, building energy analysis, and solar radiation. Over the years, a significant outcome of the Programme's work has been the number of demonstration projects constructed and monitored in the member countries.

With researchers from the 21 member countries involved in numerous projects under eight Tasks and a Working Group, many notable results were achieved this year. These included the successful completion of Tasks 13, 14 and 16; presentations by experts and Operating Agents of Tasks 13 and 20 at the ISES EuroSun '96 conference; and, a Task 18 exhibit and plenary lecture given by the Operating Agent at Glastec '96, Europe's largest glass and glazings trade fair.

Every year our annual report includes a feature article on some aspect of solar technologies for buildings. This year's article, *20 Years of Making Buildings Better Using Solar Energy*, celebrates the Programme's achievements in the field of solar energy. I would like to express my sincere thanks to all the Executive Committee members and Operating Agents, who over the past two decades have contributed their expertise, time, and enthusiasm to make the Solar Heating and Cooling Programme a successful international endeavor.

HIGHLIGHTS OF THE TASKS AND WORKING GROUP

Notable achievements of the Programme's work during 1996 are mentioned below. The details of these and many other accomplishments are covered in the individual Task summaries later in this report.

Task 13

Solar Energy Houses: Strategies, Technologies, Examples, a book published by James & James Science Publishers, presents details on the results and technologies used in the 14 experimental buildings built under this Task. These buildings demonstrate how new and innovative passive and active solar concepts as well as advanced energy conservation measures can result in a 75 percent reduction in purchased energy.

Task 14

Two reports were published. The *Large Solar Energy Systems* report discusses the major lessons learned from three large-scale heating systems studied under Task 14. And, the *Advanced Solar Domestic Hot Water Systems* report focuses on the significant performance improvements that advanced "low flow" DHW systems can achieve.

Task 16

Photovoltaics in Buildings: A Design Handbook for Architects and Engineers was published in March by James & James Science Publishers in time for the Task's final symposium, the 1st International Solar Electric Buildings Conference held in Boston, Massachusetts, USA. Task results were presented at this symposium to an international audience of over 800 professionals from the building sector, PV technology industries, utilities, research institutions, and others working in the solar energy field.

Task 18

A database was created in Microsoft Access to process Task results and serve as a basis for disseminating Task information and results to a wider audience. The database categorizes each glazing, identifies the samples distributed and which laboratories received them, and records the performance measurements and results obtained. It also includes a directory of Task participants and other Task information.

Task 19

Laboratory testing of solar air collectors began at the ARSENAL in Vienna, Austria, and will continue into 1997. The test procedure reflects the latest developments in determining an international standard for such systems.

Task 20

A Task extension was approved by the Executive Committee. The new work will focus on monitoring the performance of solar energy technologies for space heating, domestic water heating, and lighting in existing residential and non-residential buildings.

Task 21

An 8-page color Task brochure was written in collaboration with the IEA Energy Conservation in Buildings and Community Systems Programme to inform industry and building design practitioners of the collaborative research on daylighting being undertaken by 38 institutions in 16 of the Programme's member countries.

Task 22

Research activities in this Task were initiated. A draft working document was prepared by the Finnish Task participants which summarizes a variety of closed-form analytical solutions developed to test the accuracy of building energy analysis tools in analyzing specific heat transfer phenomena.

Working Group on Materials in Solar Thermal Collectors

Leadership of the Working Group was turned over to Germany from Sweden. Two new projects were initiated on the durability and testing of absorber coatings and evacuated collectors.

NEW PROJECTS

The Project Definition Phase of Task 23, Optimization of Solar Energy Use in Larger Buildings, began in April 1996 and will continue to June 1997. During this phase, Task participants are developing a work plan and national participation plans, in addition to beginning work on Subtask A: Case Stories. The Task's focus is on large scale, urban buildings and ways to optimize the combined use of different energy conservation and efficiency technologies.

At its October meeting, the Executive Committee approved the Project Definition Phase for a new Task on solar procurement of active solar systems. The Task objective is to achieve a performance and cost breakthrough for active solar systems and to increase their market share through collaborative buying initiatives.

SPECIAL WORKSHOPS

Canada organized the workshop Solar Innovations '96 in Toronto, Canada. It was the first international workshop held on residential solar water heating. The workshop provided a forum for information exchange between the 60 participants from 10 countries representing industry, utilities, and research institutions.

Sweden organized a workshop on solar procurement held April 1996 in the Netherlands. The participants' input on the feasibility of a Task on cooperative procurement and cost-efficient equipment for active solar systems supported the initiation of the new SHC Task on solar procurement of active solar systems.

ISES

The SHC Programme and two Tasks participated in the September ISES EuroSun '96 conference in Freiburg, Germany. In celebration of the Programme's 20th anniversary, the chairman presented a special 20th anniversary slide show which was followed by a reception. Also, Programme information was distributed at an exhibition booth. Tasks 13 and 20 organized conference sessions to present their Task results. Eleven Executive Committee members and Operating Agents attended the conference.

MANAGEMENT ACTIONS

As part of a process to develop an effective Task evaluation process, trial evaluations of Tasks 16, 19 and 20 were conducted by the Executive Committee. After reviewing these evaluations, it was agreed to revise the evaluation process. A new evaluation procedure has been adopted by the Executive Committee, based on criteria included in the Programme's strategic plan, which requires each Operating Agent to conduct a mid-term and final evaluation.

The Executive Committee adopted a new policy on collaborative Tasks. The policy is intended to clarify the roles and responsibilities of two Implementing Agreements and the Executive Committees which have agreed to work together on a new Task. An implementation plan for the new policy also was adopted by the Executive Committee.

A process to revise the Programme's information plan was initiated. This work will be continued in 1997 as part of a review of the Programme's strategic plan.

The Software Policy Committee continued to work on strengthening the Programme's software policy concerning intellectual property rights, distribution and licensing requirements and procedures, and other related issues.

The SHC Programme enhanced its World Wide Web site. The web site includes general program information, individual "pages" for each current Task, the *Solar Update* newsletter, information on SHC publications and upcoming meetings, and names of contacts in each participating country. This annual report can also be found on the SHC web site.

To celebrate the Programme's 20th anniversary, a traveling display and 2-screen slide show were prepared with the theme, "20 Years of Making Buildings Better Using Solar Energy." Both the display and slide show highlight the Programme's contributions to the advancement of solar energy over the last two decades.

Two Executive Committee meetings were held in 1996--a May meeting in Almeria, Spain and an October meeting in Rome, Italy.

COORDINATION WITH OTHER IEA AGREEMENTS

Coordination with the Energy Conservation in Buildings and Community Systems (BCS) and Photovoltaic Power Systems (PVPS) Programmes continues. A joint BCS/SHC meeting is planned for the November 1997 Executive Committee meeting in Australia. The transfer of SHC Task 16 results on building-integrated PV and design to the new PVPS Task has been completed. This Programme looks forward to collaborating on this Task with the PVPS Programme.

PUBLICATIONS

The following IEA Solar Heating and Cooling reports were published in 1996 and are not listed elsewhere in the annual report:

Version 2.0 of ADELINE Software (Advanced Daylighting and Electric Lighting Integrated New Environment).
H. Erhorn and J. Stoffel. May 1996 (Task 12).

Atrium Models for Analysis of Thermal Comfort and Energy Use.
L. Bryn and P.A. Schiefloe. March 1996, Report #T.12.A.3-1 (Task 12).

Improved Measurements of Solar Irradiance by Means of Detailed Pyranometer Characterization.
D.I. Wardle et al. April 1996, Report #IEA-SHCP-9C-2 (Task 9).

Using Pyranometers in Tests of Solar Energy Convertors.
L.J.B. McArthur et al. November 1995 (Task 9).

ACKNOWLEDGMENTS

In closing, I would like to thank the Operating Agents and Working Group Leader, our Executive Secretary, Pamela Murphy, and our Advisor, Fred Morse, for their work on behalf of the Programme. All their efforts are essential to the Programme's continued success.

Feature Article: 20 Years of Making Buildings Better Using Solar Energy

Pamela Murphy
Morse Associates, Inc.
United States

INTRODUCTION

The replacement of conventional fuels with renewable fuels is essential if we are to achieve a sustainable energy future. As a non-polluting, safe, and indigenous renewable energy source, solar energy is a critical component of a renewable energy mix. The member countries of the International Energy Agency (IEA), understanding the importance of alternative fuel sources, are working collaboratively on the development of new and improved energy technologies to diversify energy supplies that can sustain growth while having a minimal impact on the environment. This international undertaking of energy cooperation and research has contributed significantly to the advancement of renewable energy and technology.

The progress made in solar heating and cooling over the past 20 years is due, in part, to the IEA Solar Heating and Cooling (SHC) Programme and the related work of the national programs within the IEA countries. Since 1977, the 20 member countries and the European Commission have been collaborating to develop technologies which use the sun to heat, cool, light, and power buildings.

Technological areas in which the SHC Programme has made important contributions include:

Solar Materials R&D

- Selective absorber materials
- Collector and window glazings
- Heat transfer and thermal storage media
- Methods for durability testing

Advanced Glazing Materials

- High performance glazings
- Optical switching glazings
- Transparent insulating materials
- Light transport materials
- Application assessment
- Daylighting

Building Energy Analysis

- Algorithms for atria, transparent insulation materials, and optical switching glazings
- Software such as BESTEST (Building Energy Simulation Test) and ADELINE (Advanced Daylighting and Electric Lighting Integrated New Environment)

Solar Radiation Data

- Measurement and estimation techniques
- Irradiance measurements for solar collector testing
- Improved spectral radiation data for PV and advanced glazing applications
- Representative climatic design years

Based on the advances made in these fields, the SHC Programme has taken the next step and successfully applied these solar technologies to buildings. Using solar technologies to supply energy for all building applications--heating, cooling, hot water, lighting and electricity--not only addresses the growing energy needs throughout the world, but also taps a large inexhaustible resource that benefits the environment and the economy. However, stating that solar energy is a viable resource is not enough.

DEMONSTRATING THE VALUE OF SOLAR ENERGY

The potential for reducing the use of purchased energy in the building sector is immense. In the IEA member countries, an average 30 percent of the total energy consumed is used to provide energy for residential and non-residential buildings.

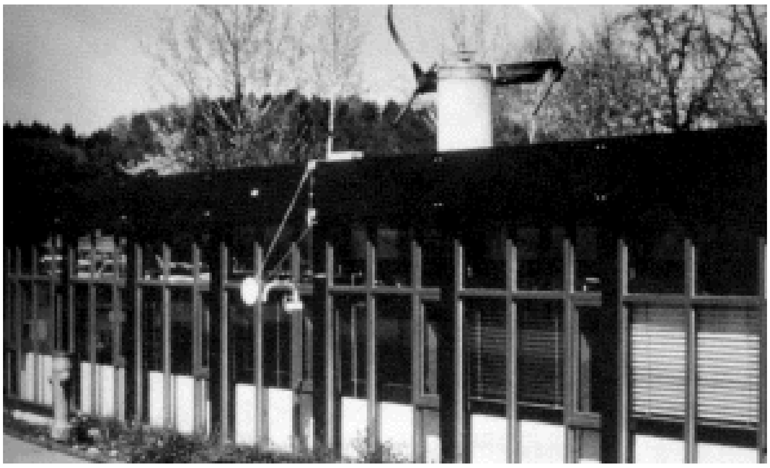
Solar technologies can make a major contribution in meeting this need. The fundamental objective of the SHC Programme over the past two decades has been to make solar energy a working reality by developing technologies that are reliable, economical, adaptable by industry, and acceptable to the public.

SHC researchers have worked or are working on many solar technologies and their application to improve buildings. The Programme's most recent achievements in specific building applications are highlighted below.

Passive Solar Commercial Buildings

In this area, the SHC Programme has explored new opportunities for using the sun's energy to heat and light commercial buildings. Researchers focused on the intensity and timing of internal gains, requirements for faster payback, and non-owner occupancy as these posed the greatest constraints on solar applications in commercial building. Under Task 11, experts assessed the potential of various solar concepts and the influence of the constraints by surveying, monitoring, and computer modeling 43 existing and planned buildings in 12 countries. The detailed monitoring conducted by Task experts provided much needed information on the integration of solar and mechanical systems, optimization of control systems, and interaction between people and systems. And, the development of two computer algorithms, SUPERLINK and DAYLINK, which linked daylighting models with thermal models, thereby facilitating the necessary parametric studies conducted.

The Haas & Partners office building in Switzerland is one of more than 20 examples of successful solar applications monitored under Task 11. Through the application of solar technologies, the annual purchased energy requirements for the building were reduced to 34 kWh/m2, one of the lowest auxiliary heating requirements for an office building in Switzerland. Integrating the following passive solar features into the building reached this impressive energy saving: window and facade air collectors connected to a subfloor rock bed; earth sheltered construction on the north and west facades for natural cooling; movable absorber and insulation panels for indirect thermal gain; and direct daylighting.

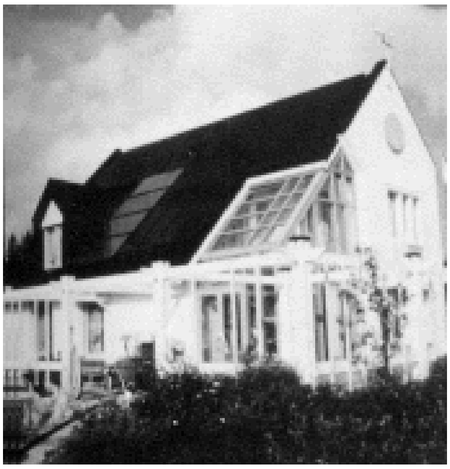


Office of Haas & Partners in Jona, Switzerland

Advanced Solar Low-Energy Buildings

Advancing solar building technologies to the point where the use of purchased energy in residential buildings can be reduced or even eliminated was the goal of the Programme's work in this area. Task 13 achieved this goal through the identification, development, and testing of new and innovative concepts using passive and active solar, photovoltaics, and advanced energy conservation technologies. The most promising and effective concepts were incorporated into the design of 14 experimental houses. These houses were designed as "total systems" addressing all energy uses. For example, a house might install solar technologies as well as energy efficient appliances and lighting, high performance windows, and super insulation. Building monitoring revealed that this work successfully integrated technologies to achieve an average total energy consumption of 44 kWh/m2 per year of heated floor area compared to 172 kWh/m2 for the typical house, a 75 percent reduction. The total solar contribution to these houses averages 37 kWh/m2 which includes passive solar gains, active solar, and photovoltaics.

The houses built under Task 13 reflect diverse cultures in their design and construction, and represent extremes in climate, ranging from very cold, in Scandinavia and Canada, to quite warm, in parts of the United States and Italy. An example is the house built in Finland, on a beautiful lakefront site in Pietarsaari, which features a 2 kWp photovoltaic system, solar thermal collector, and a ground-coupled heat pump. This house achieved one of the lowest purchased energy consumption levels in the Task, 27 kWh/m2.

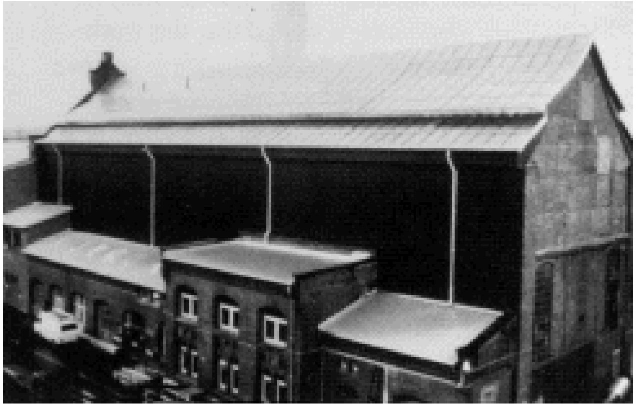


Single Family House in Pietarsaari, Finland

Advanced Active Solar Energy Systems

Programme experts have been examining state-of-the-art active solar energy systems through computer simulation models, development and testing of new components and systems, and the design, construction and monitoring of operating systems. The solar system applications researched and developed include solar domestic hot water, ventilation air and space heating for commercial buildings, and large-scale heating below 200°C. The results obtained have not only improved these technologies, but also promoted their application in buildings. For example, six countries participating in Task 14 developed solar domestic hot water "dream systems," three countries commercialized their systems as leading edge systems, and other countries marketed a variety of improved components and systems. Overall, this work developed technologies which have realized cost/performance improvements of up to 50 percent.

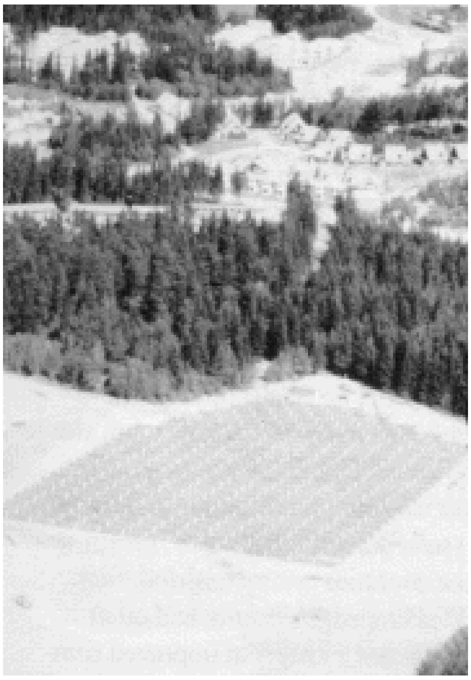
Another area significantly impacted by the Programme's work is solarwall air heating. Task 14 spearheaded much of the research conducted on the innovative perforated absorber. In fact, the perforated absorber was a direct product of bringing experts and industry representatives from various countries together at an IEA workshop. Task 14 experts also monitored the first perforated solarwall in Europe which was installed on a renovated co-generation plant in Gottingen, Germany. The solarwall preheats combustion air used by the boilers in the gas-fired plant operated by the local utility. Since the installation of the solarwall, boiler efficiency has increased by 1-1.5 percent, providing an annual energy savings of 130 Mwh.


Co-generation plant in Gottingen, Germany

Central Solar Heating Plants with Storage

Programme collaboration in this field has brought CSHPSS technology from what was once considered an impractical idea to the market and bolstered its widespread use. Several projects undertaken were in northern countries where solar heating of buildings seemed to be an unrealistic proposition--in the wintertime, when heat is most needed, there is virtually no solar radiation to use. While long-term storage could make the energy available when needed, the economics of seasonal storage was only feasible if done on a large scale. Therefore, the Programme began to investigate in the early 1980's the feasibility and cost-effectiveness of central solar heating plants with seasonal storage. The Programme has maintained steady involvement in this area through specific Task work and forums designed to continue the transfer of knowledge, nationally and internationally, on CSHPSS for residential heating, district heating, and process heating at moderate temperatures.

One of the many success stories is the CSHPSS plant in Lyckebo, Sweden. Heat is supplied to the district heating system by a solar collector area of 4,320 m2 and a 100,000 m3 rock cavern storage area. The system provides heat for five hundred and fifty homes.


Central solar heating plant with seasonal storage in Lyckebo, Sweden

Photovoltaics in Buildings

Photovoltaics in building technology and applications has taken a giant step forward because of the Programme's collaborative research conducted by Task 16 experts. In 1990 the Programme took on the challenge of how to meet both the architectural and engineering aspects of building integrated photovoltaic systems. In tackling this technology, experts addressed the relationship of PV systems with solar thermal and/or conventional energy components in buildings, explored new PV systems and components, and dealt with the technology's economic competitiveness. Task achievements include the introduction of new products to the market, construction of 17 buildings throughout Europe and North America, and the sharing of research results and know-how around the world. Perhaps the greatest accomplishment has been to show both architects and engineers that PV is a viable and attractive energy option.

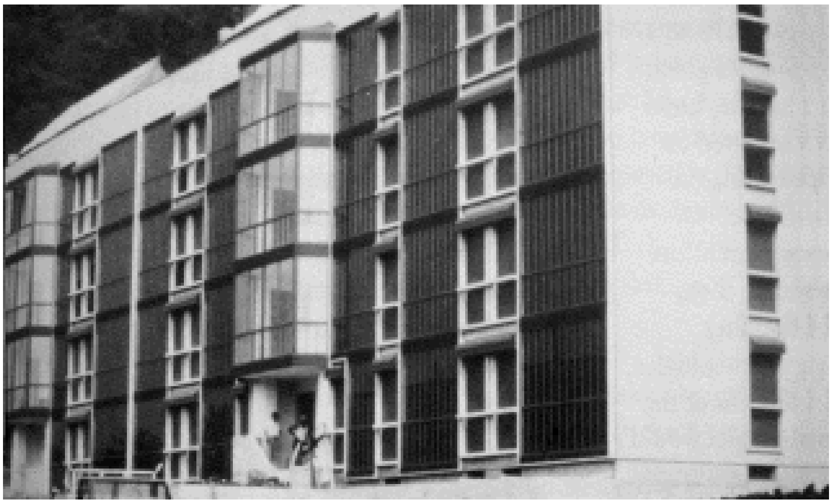
The Lord house is one of the 17 commercial and residential buildings designed and monitored under Task 16. This house, which is approximately 250 m2, uses the sun to produce heat, hot water and electricity. The south roof has an integrated array of solar thermal collectors and large-area PV modules which form a single, uniform glass pane. What makes this house unusual is that it does not have a roof beneath the solar panels--the panels are the roof. The house also incorporates passive solar heating and cooling, super insulation, R-8 windows, monolithic air and vapor barriers, air-lock vestibules, and a heat recovery ventilation system.

The Lord House in Cape Porpoise, Maine, USA

Solar Air Heated Buildings

To advance the application of solar air systems in buildings, the Programme is testing and demonstrating several different systems. The advantages of solar air heating systems are many, such as they require no protection from freezing temperatures, leaks pose no damage to the building structure or its contents, and they are compatible with mechanical ventilation. Unfortunately, these systems are often not considered in building construction or renovation. To increase the application and improve the cost-effectiveness of this technology, Task 19 experts are monitoring exemplary buildings and examining additional uses these systems can serve, such as admitting daylight, inducing cooling, providing sunshading, generating electricity, and preheating domestic hot water. To encourage the use of solar air systems, Task experts are helping building designers and others to better understand the different systems and to select one which meets their needs.

An Italian apartment building in Marostics, which is being monitored under Task 19, demonstrates the benefits of coupling solar air systems and water heating systems to make use of the otherwise wasted solar gains during the summer. The building uses thermosyhphon air collectors which form part of the facade and south facing windows for passive solar heating. Solar energy storage is located in ceiling units.

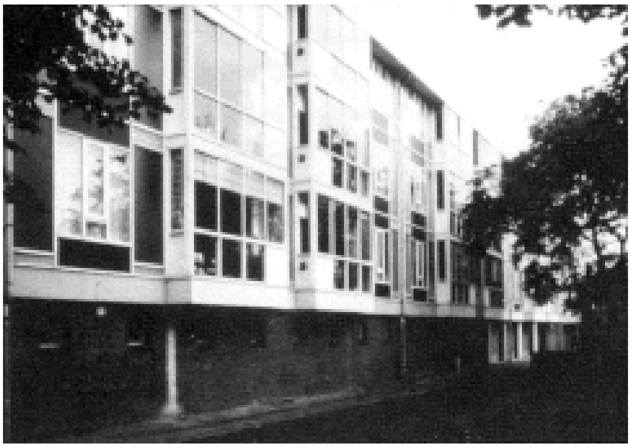


Apartment building in Marostics, Italy

Solar Energy in Building Renovation

Existing buildings, which dominate the building sector, account for a large share of the overall energy use in buildings. Therefore, if solar energy is to gain a more prominent place in the energy market, solar technologies must be integrated effectively and economically into the building renovation process. Energy considerations often are not the driving force behind building renovation, and that presents a challenge for increasing the application of solar technologies in buildings. The key to using solar measures is to add value to the solution of a particular renovation problem, for example, to integrate solar technologies when replacing the roof or windows, repairing the building facade, replacing the heating and ventilation system, or changing the use of the building. Task 20 researchers are developing strategies and guidelines for integrating solar technologies in residential and non-residential building renovation as a means to encourage greater use of these technologies.

The Reitse Hoeve apartment building in the Netherlands demonstrates the impact solar technologies can have in building renovation. Renovation of this apartment building reduced fuel requirements by 30 percent; the solar system contributed 64 percent of that reduction. A variety of technologies were used both to save energy and to improve these apartments, including air collectors integrated into the south facade for preheating ventilation air, glazed balconies on the south facade, glazed galleries on the north facade, better windows, and additional insulation.



Reitse Hoeve apartment building in Tilburg, Netherlands

CONCLUSION

The Solar Heating and Cooling Programme buildings highlighted above show how great an impact solar technologies can have on the energy use of individual buildings. For example, Programme results show that advanced solar low-energy technologies can meet 75 percent of a building's total energy demand and solar air heating technology can generally meet 40 percent of the heating demand required for a building.

Programme results such as these suggest the potential effect that solar energy can have on a country's entire building sector. Studies generally show that slightly more than half the buildings in a country are not properly oriented or designed for solar technologies. With that in mind, in the United States for example, residential buildings account for 41 percent of the energy demand in the building sector, therefore, if every suitable residential building applied advanced solar low-energy technologies, which are capable of meeting 75 percent of the total energy demand, the national impact would be dramatic. Solar energy could also significantly impact the heating demand of commercial and residential buildings, which is 12 percent and 38 percent, respectively. Capable of meeting up to 40 percent of the heating demand, solar air heating systems could have a dramatic impact if incorporated into suitable new and existing buildings.

To achieve the full potential of these and other solar technologies, increasing their market share is necessary. The rate at which solar technologies enter the market is critical, but sometimes hard to control. Market factors which will help to determine the success of solar technologies include competitive costs, high technology performance, government and industry incentives/ subsidies, and location and orientation. Initiatives, such as those taken by the SHC Programme, are a means for addressing some of these market factors and encouraging the successful commercialization of solar technologies.

As an energy source, solar energy should not and cannot be overlooked, and that is why the IEA Solar Heating and Cooling Programme intends to continue its work into the 21st century. The IEA provides a unique framework within which collaborative, results-oriented work is identified, planned, and accomplished. And, the resources and dedication of the many countries and people involved in the Programme are a guarantee that solar energy's share will continue to grow in the energy sector.

PREVIOUS CONTENTS NEXT

Task 13: Advanced Solar Low-Energy Buildings

Prof. Anne Grete Hestnes
The Norwegian Institute of Technology
Operating Agent for The Royal Ministry of Petroleum and Energy, Norway.

TASK DESCRIPTION

Objective

The objective of the Task was to advance solar building technologies through the identification, development, and testing of new and innovative concepts which have the potential for eliminating or minimizing the use of purchased energy in residential buildings while maintaining acceptable comfort levels.

Scope

The focus of the Task was the application of passive and/or active solar technologies for space heating of single family and multi family residential buildings. The use of passive and active solar concepts for cooling, ventilation, and lighting was addressed, as well as advanced heating and cooling loads.

Since the emphasis was on innovation and longrange (after the year 2000) cost-effectiveness, the materials, components, concepts, and systems considered did not need to be currently feasible, economical, or on the mass market. The knowledge regarding the properties of materials and components aquired in Task 10 and the experiences gained on designing and evaluating solar buildings in Tasks 8 and 11 were important inputs to the Task.

Means

In order to accomplish the Task's objective, the Participants undertook work in three areas:

Subtask A: Development and Evaluation of Concepts (Germany)

This Subtask identified materials, components, and whole building concepts that had the potential for significantly reducing energy use, determined performance criteria, performed simulation studies to evaluate expected performance, and developed experimental building designs.

In order to facilitate the simulation of the new and often compolex technologies and building designs, a special group, the Simulation Support Group, was set up within the Subtask. This group provided support to the various teams doing simulation studies.

Subtask B: Testing and Data Analysis (Denmark)

This Subtask was responsible for both the testing of materials and components and for the monitoring of the Task 13 experimental buildings. It selected materials and components to be tested, reviewed and agreed on the experiments to be performed, developed monitoring, instrumentation, evaluation, and reporting requirements for the experiments, and in some cases also arranged for the use of other countries test facilities.

Subtask B also developed monitoring, instrumentation, evaluation, and reporting requirements for the experimental buildings and reviewed the results of the monitoring of these buildings. As this activity is not yet completed, the Subtask Leader has proposed an extension of the work within the framework of an IEA Working Group.

Subtask C: Synthesis and Documentation (Switzerland)

This Subtask dealt primarily with dissemination of Task results. As a starting point, it reviewed the performance of existing advanced solar residential buildings, the monitoring technoques used, and what could be learned from those experiences. It then compiled the designs of the Task 13 building designs, produced working documents and technical reports on technologies and on simulation and testing activities, and prepared a book of Task results. Subtask C also planned and conducted two Task symposia.

Participation

Fourteen countries plus the European Commission participated in the Task:

Austria	Japan
Belgium	Netherlands
Canada	Norway
Denmark	Sweden
European Commission	Switzerland
Finland	United Kingdom
Germany	United States
Italy	

Approximately 45 experts from these countries participated in the Task's work. They comprised both researchers, from public and private universities and research institutions, and architects and engineers, from private consulting companies.

The research phase of the Task started on September 1, 1989 and concluded on September 1, 1996, after a two-year extension.

SUMMARY OF TASK WORK

The objective of the Task was reached through a number of activities, the most important being the development and testing of whole building concepts.

- Eleven countries constructed fourteen experimental buildings.

Belgium/E.C.	The PLEIADE rowhouse unit in Louvain-la-Neuve

Canada	The Advanced House in Brampton, Ontario The Green Home in Waterloo, Ontario
Denmark	The Solsikkeparken rowhouses in Vonsild, Jutland
Finland	The IEA5 Solar House in Pietarsaari
Germany	The Zero Heating Energy House in Berlin The Ultra House in Rottweil
Japan	The WISH House 3 in Iwaki
Netherlands	The Urban Villa in Amstelveen
Norway	The IEA rowhouse unit in Hamar
Sweden	The low cost prototype at Rörskär
Switzerland	The duplex in Gelterkinden
USA	The Exemplary House at Grand Canyon The Exemplary House at Yosemite

- Task Buildings have been presented in videos and TV programs in several countries, and are visited by numerous groups from kindergarten classes to journalists. In Canada, the "Green Home" is featured as part of an educational program on high energy and resource use for school children.

- Information dissemination includes: the Final Task 13 report, Solar Energy Houses: Strategies, Technologies, Examples, numerous working documents and technical reports, a booklet on the building designs, a bruchure on the buildings, and a homepage on the World Wide Web, and two symposiums--in Stuttgart, Germany in 1993, and at the EuroSun '96 conference in Freiburg, Germany in 1996.

- Production of reports and books in other languages which use Task 13 as the basis. For example, the Belgian and Dutch experts are writing a book in Dutch and French, and the German and Swiss experts are producing various materials in German.

For the first time, a building related Task has successfully integrated all solar technologies (i.e., passive, active, and photovoltaic technologies) resulting in new buildings which use only 25% of the energy used in typical residential buildings.

TASK 13 ACCOMPLISHMENTS
Fourteen experimental buildings with exceptionally low total energy use Substantial new knowledge about/experience with: • advanced solar technologies • simulation and monitoring of solar buildings • design processes • cooperation with builders and contractors • user behavior and user reactions to solar technologies A number of technical reports, a brochure, a booklet, and a book. Two international symposia and a number of national seminars

LINKS WITH INDUSTRY

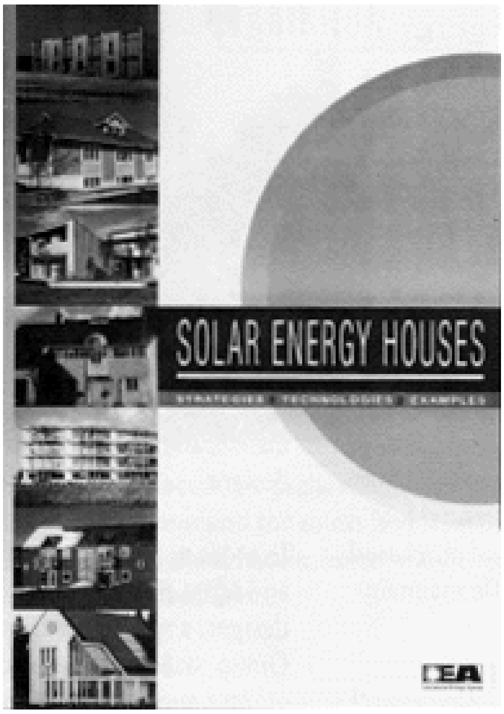
Industry involvement in Task 13 has been indirect but significant. The main activity in the Task was the development, construction, and monitoring of experimental buildings. In this activity, the building industry in the different countries was strongly involved, both by participation in design development, by providing materials and components to be used in the buildings, and by constructiong the buildings. In several cases, this has resulted in a continuing cooperation between the industry and the research institutions involved.

In addition, some building manufacturers are using Task results. For example, in Germany the main prefab housing manufacturer has included the Berlin Zero Heating Energy concept in his catalogue and constructed a prototype, in the Netherlands a refined version of the Urban Villa is under construction, and in Sweden a major social housing organization formed a company together with the Swedish Task 13 participants which will include the Swedish concept in it's portfolio.

REPORTS PUBLISHED IN 1996

High Performance Building Construction Assemblies and Details: The IEA Task 13 Experience (Technical Report)

Solar Energy Houses: Strategies, Technologies, Examples (Book). James & James Science Publishers Ltd, ISBN 1-873936-69-9.



This book provides details on the 14 houses built under task 13. It is a valuable reference book for the architect and planner as well as the engineer

TASK 13 NATIONAL CONTACT PERSONS

Operating Agent

Anne Grete Hestnes
Department of Architecture, NTNU
N-7034 Trondheim
Norway

Austria

Helmut Krapmeier
Institut fÿr Sinnvollen Energieeinsatz
Bahnhofstrasse 19, Postbox 51
A-6851 Dornbirn

Belgium

André De Herde
Architecture et Climat, UCL
Place de Levant 1
B-1348 Louvain-la-Neuve

Canada

Steve Carpenter

Enermodal Engineering
650 Riverbend Drive, Kitchener
Ontario N2K 3S2

Denmark

Bjarne Saxhof
Department of Buildings and Energy
Building 118, DTU
Dk-2800 Lyngby

EEC

Peter Wouters
WTCB/CSTC
Violetstraat 21-23
B-1000 Brussels
Belgium

Finland

Jyri Nieminen
VTT, Building Technology
P.O.Box 18011
FIN-02044 VTT

Germany

Hans Erhorn
Fraunhofer Institut fÿr Bauphysik
P.O.Box 800 463
D-70504 Stuttgart

Italy

Stella Harangozo
ENEA, C.R.E. Casaccia
00060 S.Maria Di Galleria
Roma

Japan

Ken-Ichi Kimura
Department of Architecture
Waseda University
Okubo-3, Shinjuku
Tokyo 169

Netherlands

Bart Poel

DAMEN Consultants
Postbox 694
NL-6800 AR Arnhem

Norway

Øyvind Aschehoug
Faculty of Architecture, NTNU
N-7034 Trondheim

Sweden

Gudni Johannesson
Div. of Building Technology
KTH
S-10044 Stockholm

Switzerland

Robert Hastings
Solararchitektur
ETH - Hönggerberg
CH-8053 Zurich

United Kingdom

John Littler
Research in Building Group
University of Westminster
35 Marylebone Road
London NW1 5LS

United States

Doug Balcomb
National Renewable Energy Laboratories
1617 Cole Blvd.
Golden, Colorado 80465

PREVIOUS CONTENTS NEXT

Task 14: Advanced Active Solar Energy Systems

Doug Lorriman
Ballinafad Research
Operating Agent for Natural Resources Canada

TASK DESCRIPTION

Task 14 was initiated to advance the state-of-the-art in active solar energy systems. All Task experts were working on the leading edge of system development within their own countries and brought their expertise together within the Task to accelerate advancements in this field. Task activities included development of computer simulation models for advanced system features, development and testing of new components and systems and design, and construction and monitoring of actual operating systems.

System applications included in the Task were:

- Domestic Hot Water
- Ventilation Air and Space Heating for Commercial Buildings
- Large Scale Heating under 200°C.

Activities of the Task began in January 1990. The final reports of the Domestic Hot Water and Large Systems Working Groups were completed in 1996 and the final reports of the Air Systems Working Group and the Dynamic Testing Subtask are expected to be completed in early 1997.

Working Groups

The goal of the Working Groups was to facilitate interaction between participants with similar projects. Participants in these Working Groups identified and addressed issues of common concern, exchanged knowledge and experience and identified prospective collaborative activities. Working Groups were established in the following areas:

- Domestic Hot Water Systems (United States)
- Air Systems (Canada)
- Large Systems (Lead position rotated between Sweden, Germany, the Netherlands and Spain. The final lead country was the Netherlands.)

Innovative Concepts Subtask (United States)

This Subtask was established to provide a mechanism for the ongoing sharing of new ideas on active solar heating among the Task participants. Work of the Subtask helped to identify promising concepts which offered improvements in cost, performance and/or reliability. Meetings of the Subtask typically involved informal presentations and discussion of new concepts which had been identified by the participants and could be of interest to other Task participants in their projects.

Dynamic System and Component Testing Subtask (Switzerland)

This Subtask became part of Task 14 during 1992. The Subtask was established to further develop the work done by the IEA Dynamic Systems Testing Group which submitted its final report early in 1992. The general goals of the Subtask were:

- Develop short-term component test procedures
- Develop test procedures for SDHW systems that are not covered by the existing Dynamic System Testing Model.
- Perform tests to validate the procedures.
- Develop methods for rating and performance prediction of large systems.
- Evaluate the need for a user friendly modelling tool for system simulation layout, and optimization.

TASK 14 ACCOMPLISHMENTS

Solar Domestic Hot Water Systems

- Cost/Performance improvements of up to 50%.
- Sysytems, Components and concepts commercialized in most participating countries.

Air Systems

- Cost/Performance improvements of up to 60%.
- Technology introduced in many European countries.

Large Systems

- Experience documented.
- International network of experts strenghened.

Dynamic Component and System Testing

- Procedures developed to significantly reduce time and cost.
- Important input to ISO and CEN.

ACTIVITIES DURING 1996

Work of the Task during 1996 was solely concentrated on the preparation of the final reports. The final reports on Solar Domestic Hot Water and Large Systems have been completed and the Air Systems and the Dynamic Testing reports are near completion.

1996 MEETINGS

There were no formal Task Experts meetings held in 1996. However, an informal meeting was held among experts who attended the Solar Innovations 96 Workshop in Toronto, Canada.

This is the first in what the experts hope will be a series of periodic meetings to maintain the network which was established during the Task.

FUTURE WORK

At this point the Task is effectively finished. The only work remaining is the completion of the two remaining final reports which is anticipated in the next few months. There are no future meetings planned.

LINKS WITH INDUSTRY

Industry involvement was successfully encouraged throughout the Task. There was no specific industry participation this past year since activity concentrated on report writing. However, industry representatives did, at appropriate times, make significant contributions to the reports.

REPORTS PUBLISHED IN 1996

Advanced Solar domestic Hot Water Systems (Technical Report)

Large Solar Energy Systems (Technical Report)

REPORTS TO BE PUBLISHED IN 1997

Dynamic Testing of Active Solar Heating Systems (Technical Report)

TASK 14 NATIONAL CONTACT PERSONS

Operating Agent

Doug Lorriman
Ballinafad Research
P.O.Box 97
Ballinafad, Ontario N0B 1H0
Canada

Canada

D. McMlenehan
Alternative Energy Division
CANMET
Natural Resources Canada
580 Booth St., 7th Floor
Ottawa, Ontario K1A 0E4

Denmark

S. Furbo
Thermal Insulation Laboratory
Technical University of Denmark

Building 118
D.K. 2800 Lyngby

Germany

K. Vanoli
Institute für Solarenergieforschung
Am Ohrberg 1
31860 Emmerthal

Netherlands

T.P. Bokhoven
Solair Systems B.V.
Middelbok 210
2831 BR. Gouderak

Spain

J.I. Ajona
IER-CIEMAT
Avada Complutense 22, Madrid
Madrid 28040

Sweden

Per Isakson
Royal Institute of Technology
Department of Building Services
s-100 44 Stockholm

Switzerland

P. Bremer (deceased)

United States

C. Kutscher
National Renewable Energy Laboratory
1617 Cole Blvd.
Golden, Colorado 80401

Task 16: Photovoltaics In Buildings

Dr. Heribert Schmidt
Fraunhofer Institute for Solar Energy Systems
Operating Agent for Forschungszentrum Jülich, Germany

TASK DESCRIPTION

Photovoltaic power supply for buildings utilizes a decentralized approach for electricity generation. It offers the possibility to match supply and demand and thus to reduce transmission losses, peak power, and storage. For system optimization, all energy aspects such as lighting, heating and cooling, and hot water production have to be taken into account.

Task 16 assessed techniques for maximizing the solar share in total energy concepts as well as optimizing the economics. Results of these findings were incorporated into Task 16 demonstration projects which were undertaken in most of the Task 16 member countries (see Table 1). Both residential and commercial buildings and as well as grid-connected and stand-alone buildings were included.

TABLE 1.
Overview of IEA Task 16 PV Demonstration Buildings

No.	Building	Location	End date of monitoring program
1	Photovoltaic Demo-House W. Weiss	Gleisdorf, Austria	December 1995
2	Vienna Low Energy House	Vienna, Austria	December 1995
3	13 kW-PV-facade Wild	Innsbruck, Austria	December 1995
4	Innova House	Kanata, Ontario, Canada	December 1994
5	The Hugh MacMillian Rehabilitation Centre	Toronto, Canada	December 1995
6	Pietarsaari Solar House	Pietarsaari, Finland	December 1995
7	Rural Residence "Stein"	Röhrmoos, Munich, Germany	November 1994
8	Structural Glazing PV-facade	Berlin-Kreuzberg, Germany	Spring 1995
9	PV-facade for the Northumberland Building	Newcastle upon Tyne, UK	Spring 1996
10	Energy Autonomous PV-house	Woubrugge, The Netherlands	December 1994
11	Norwegian Solar Low Energy Dwelling	Hamar, Norway	n.a.
12	Four PV Grid Connected Houses	Pozuelo, Madrid, Spain	December 1995
13	Stockholm House	Stockholm, Sweden	August 1995
14	Affoltern	Zürich, Switzerland	December 1993
15	PV Cladding on LRE Building	Lausanne, Switzerland	May 1995
16	Flat Roof on DMX Building	Lausanne, Switzerland	May 1995
17	Single Family House	Cape Porpoise, USA	Spring 1996

Task 16 was divided in four Subtasks, each coordinated by a lead country:

Subtask A: System Design and Engineering (Finland)

In this Subtask, participants produced working documents on existing PV-systems, components, energy-efficient electric appliances and lighting equipment, safety issues and national regulations, codes and pricing practices for electricity generation, based on responses to questionnaires. Based on this information, recommendations and guidelines for energy concepts, utility interface issues and monitoring procedures were made.

Subtask B: Building Integration (Switzerland)

Various methods of integrating PV-modules into the building structures were investigated and tested. The development of special modules designed for building integration were undertaken, taking into account restrictions caused by building standards and safety requirements. The best integration methods were then demonstrated at the Task 16 Demonstration Site "Photovoltaic Building Elements" at EPFL in Lausanne, Switzerland.

Subtask C: PV Demonstration Buildings (Netherlands)

Based on the results of the preparatory work in Subtasks A and B, PV-buildings were designed, constructed and monitored. The data on these buildings is available to the public.

Subtask D: Technology Communication (Germany)

Based on the information gained through Subtask A, Subtask B, and the PV demonstration buildings, a design handbook for PV project planners and engineers was published. To further disseminate the Task 16 results, national workshops and an international conference with published proceedings were organized.

The Task was initiated on November 1, 1990 and concluded on April 30, 1996.

ACTIVITIES DURING 1996

Task 16 was extended for six months in order to complete monitoring, to evaluate project results, and to allow experts time to present their results at the final symposium. Therefore, only some of the subjects described in the Task description were completed during 1996.

Subtask A: System Design and Engineering

The work in this module was completed in 1995.

Subtask B: Building Integration

The PV Demonstration Site for Photovoltaic Building Elements at EPFL in Lausanne, Switzerland continued to be a highlight--a world-wide selection of government delegates, architects, building constructors, and engineers came to see the Demosite. An extension for the financing of the Demosite after the finalization of Task 16 was confirmed and construction of new pavilions are planned. Approximately 1,200 visitors have visited the Demosite since its inauguration.

Subtask C: PV Demonstration Buildings

The objective of this activity was to demonstrate and evaluate the integration of PV into buildings. For this purpose, 17 demonstration buildings were constructed by the participating countries during 1990-1994. Each design was reviewed and critiqued by the Task experts during special meetings. And after construction, each project was monitored for at least one year. Demonstration project monitor was completed in 1996 and is summarized with special highlights in the brochure *Demonstration Buildings*.

Subtask D: Technology Communication

The book *Photovoltaics in Buildings: A Design Handbook for Architects and Engineers* was published and distributed in 1996. This handbook considers the integration of photovoltaics in buildings and reviews all topics related to current state-of-the-art building-integrated PV systems. It is one of the most important outcomes of Task 16 because it includes the major results of the different subtasks. The Handbook is about 300 pages and includes more than 200 pictures and drawings.

A final conference held in Boston, Massachussetts, USA on March 4-6, 1996 concluded the work of Task 16. This conference, the 1st International Solar Electric Buildings Conference (ISEBC), was the world premier of Task 16 results. It was organized in conjunction with the Northeast Sustainable Energy Association's Building Energy Conference and approximately 800 people participated. The conferences brought together a unique combination of decision makers from the world solar community, the advanced building industry, and renewable energy industry. This conference was a major success for the Task, not only was the audience large, but many people expressed interest in learning more about the Task's results.

SUMMARY OF 1996 ACCOMPLISHMENTS

- Ongoing success of the PV Demonstration Site for Photovoltaic Building Elements at EPFL in Lausanne, Switzerland.
- The book *Photovoltaics in Buildings: A Design Handbook for Architects and Engineers* was finalized, published, and distributed.
- Ongoing involvement of industry in the Task's work.
- Monitoring of the Demonstration Buildings was completed and the major results published in a brochure.
- Task 16 hosted the 1st International Solar Electric Buildings Conference on March 4-6, 1996 in Boston, Massachusetts, USA. The conference provided an opportunity for Task 16 experts to present Task results to the 800 conference participants.
- Task information was transfered to IEA PVPS Task 7, Photovoltaic Power Systems in the Built Environment, which will continue working on building integrated PV.

LINKS WITH INDUSTRY

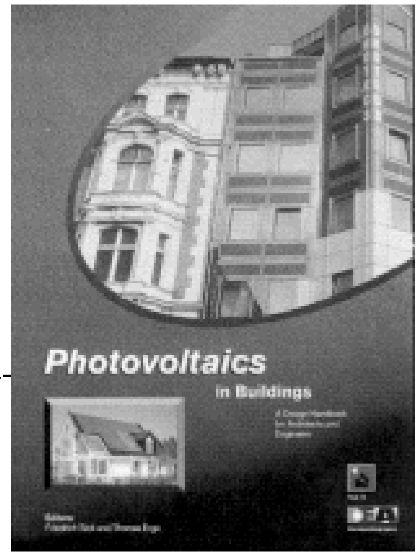
Industry representatives were active participants in several Task 16 Subtasks. In total, 14 industries and utilities were active in the Task. They included:

- Five PV-module manufacturers: Deutsche Aerospace AG, Pilkington Solar International GmbH, R&S Renewable Energy Systems, Siemens Solar, and BP-Solar.
- Six system engineering companies: Neste, PMS, IT-Power, Kandenko, ECOFYS, and Photron Canada.
- Three utilities: OKA, ENEL, and CRIEPI.

In addition to industry participation, nine research institutions and two architects were involved in the Task's work.

REPORTS PUBLISHED IN 1996

Demonstration Buildings (Internal Working Document)



Photovoltaics in Buildings - A Design Handbook for Architects and Engineers (Book)
James & James Science Publishers, ISBN 1 873963 59 1.

Proceedings of Building Energy: The 1st International Solar Electric Buildings Conference
This report can be ordered from The Northeast Sustainable Energy Association, 50 Miles St., Greenfield, MA 01301, USA, telephone: +1-413-774-6051.

The Value of Photovoltaic Electricity (Technical Report)
This report can be ordered from R. Haas (see Task Participant list at end of chapter for address)

REPORTS TO BE PUBLISHED IN 1997

German and Japanese translations of the book *Photovoltaics in Buildings - A Design Handbook for Architects and Engineers* are planned for 1997.

1996 MEETINGS

Final Task 16 conference: 1st International Solar Electric Buildings Conference
March 4-6
Boston, Massachusetts, USA

Tenth Experts Meeting
March 7
Boston, Massachusetts, USA

TASK 16 NATIONAL CONTACT PERSONS

Operating Agent

Dr. Heribert Schmidt
Fraunhofer Institute for Solar Energy Systems ISE
Oltmannsstrasse 5
D-79100 Freiburg
Germany

Austria

Reinhard Haas
TU Wien
Inst. f. Energiewirtschaft
Gusshausstr. 27-29/357
A-1040 Wien

Canada

Jimmy Royer
SOLENER Inc.
442,rue Lavigueur
Quebec, Quebec G1R 1B5

Finland

Kimmo Peippo
Helsinki University of Technology
Department of Technical Physics
Rakentajanaukio 2 C
FIN-02150 Espoo

Japan

Shogo Nishikawa
Technology & Development Laboratory,
Research & Development Headquarters,
KANDENKO Co., Ltd.
2673-169 Shimoinayoshi,
Nishiyama Chiyodamachi,
Niihari-gun, Ibaraki-ken 315

Netherlands

Tony Schoen
ECOFYS
P.O. Box 8408
NL-3503 RK Utrecht

Norway

Inger Andresen
SINTEF Architecture and Building Technology
Alfred Getz Vei 3
N-7034 Trondheim

Spain

Alvaro Gonzalez Menendez
Ciemat-IER
Avda. Complutense 22
Ed. 42
E-28040 Madrid

Sweden

Mats Andersson
Catella Generics AB

Bäling
S-82077 Gnarp

Switzerland

Peter Toggweiler
PMS Energie AG
Lindhofstr. 13
CH-8617 Mönchaltorf

United Kingdom

Bernard McNelis
IT Power Ltd.
The Warren, Bramshill Road
Eversley, Hants. RG27 0PR

United States

Steven J. Strong
Solar Design Associates Inc.
P.O. Box 242
Cambridge, Massachusetts 01451-0242

PREVIOUS CONTENTS NEXT

Task 18: Advanced Glazing & Associated Materials for Solar & Building Applications

Prof. M. G. Hutchins
Oxford Brookes University
Operating Agent for the United Kingdom Department of Environment

TASK DESCRIPTION

Objective

The objective of this Task is to develop the scientific, engineering and architectural basis which will support the appropriate use of advanced glazings and associated materials in buildings and other solar applications with the aim of realizing significant energy and environmental benefits.

Scope

This Task builds upon work begun in Task 10, Materials Research and Testing. Comprehensive measurements of key glazing performance parameters are being made for advanced glazing materials, components and window systems. Building energy analysis tools are employed to identify appropriate applications and predict energy and environmental impacts which will be derived from the use of advanced glazing products. Task 18 has a specific focus on the application and technology transfer of new materials and components with an emphasis on near-market technologies.

The Task aims to provide guidance for design engineers, building engineers and industry on the properties, use, performance and selection of advanced glazing materials. Necessary measurable parameters for specification of the thermal performance of advanced glazing materials are identified and defined and appropriate measurement test procedures are being developed.

Means

The work of Task 18 is managed under two Subtasks:

Subtask A: Applications Assessment and Technology Transfer (Australia)

Subtask B: Case Study Projects (Norway)

The 19 projects identified for inclusion within Subtasks A and B are listed below together with the lead country responsible for the management of each project :

Subtask A:

A1	Applications, potentials and characteristics (Australia)
A2/A3	Modeling and control strategies (USA)
A4	Environmental and energy impacts (Australia)
A5*	Applications guidance (UK)

Subtask B:

B1	Monolithic and granular aerogels (Denmark)
B2	Geometric media (honeycombs and capillary structures) (Germany)
B3	Chromogenic glazings (USA)
B4	Low-emittance coatings (Sweden)
B5	Evacuated glazings (Australia)
B6	Advanced solar collector covers (Switzerland) - no longer running in Task 18
B7	Angular selective transmittance coatings (Australia)
B8	Daylighting materials (Australia) - ongoing work transferred to Task 21
B9	Frame and edge seal technology (Norway)
B10*	Advanced glazing materials properties database and technology summaries (UK)
B11	Optical properties and scattering behavior of advanced glazing materials (Sweden)
B12	Measurement of the total energy transmittance of advanced glazing systems (Germany)
B13	Directional optical properties measurements of advanced glazing materials (France)
B14	Measurement of the U-value of advanced glazing systems (Netherlands)

*A5 & B10 now merged into single project

The Task was initiated on April 1, 1992 and will continue until March 31, 1997.

ACTIVITIES DURING 1996 AND WORK IN PROGRESS

Task 18 is engaged in activities which address all key issues relevant to the use of advanced glazing technology in buildings. The work encompasses basic materials research, window design and construction, performance definition, measurement and testing, simulation of energy benefits, environmental impacts, applications assessment, and information dissemination.

Glastec visitors admire vacum glazing samples prepared in Australia

In 1996 the Task made significant progress in all key areas and it is pleasing to report that after some delays almost all of the experimental work has now been completed. The research phase of the Task is due for completion on March 31, 1997. Much of the work is now centered on analysis and formal reporting. The three final technical reports of Task 18 are planned for publication in the second half of 1997. During the past year two Experts Meetings were held in Switzerland and Italy respectively. Task 18 also prepared an exhibition for Glastec '96 in Dusseldorf, Germany. A review of achievements of the past year is presented below.

Subtask A: Applications Assessment and Technology Transfer

Project A1, Applications, potentials and characteristics, was completed. This project successfully identified and defined parameters necessary to characterize advanced glazing materials and systems, identified constraints and limits of the application of advanced glazing materials, and established basic performance data.

The working document, Survey of standards & semistandards on solar and thermal properties of glazings and windows, first issued in 1994, was updated and re-issued. This document is a valuable reference work containing details of relevant international standards and draft standards. Areas covered include measurement and calculation methods for determination of U-value for glazings, shadings, windows, doors, frames and buildings, measurement and calculation methods for solar and light transmission, thermal bridge calculations, quantities and definitions, useful addresses, and details of relevant CEN and ISO technical committees and working groups.

Ten countries (Australia, Denmark, Finland, Germany, Italy, Norway, Spain, Sweden, Switzerland and the United States) have participated in building simulation analyses to evaluate the energy and comfort performance of advanced glazings. Each country selected particular simulation programs, geographic locations, building types, window systems, and control strategies for their individual analysis. Both commercial and residential buildings have been simulated by most countries. The commercial buildings varied from prototypical single-floor building modules to multi-floor buildings with ground floors, intermediate floors, and rooftop floors. Residential buildings were either single storey or two-storey with floor plans and construction typical of the participating country. The results obtained will enable recommendations to be made on the appropriate choice of glazing for climate and application and property characteristics that effect energy and comfort performance. Control strategies effecting both the building envelope and lighting system were studied. Envelope strategies included those being used with electrochromic windows to control state-switching and those used with conventional shading systems such as venetian blinds, diffusing shades etc. Lighting system strategies were related specifically to window daylight performance and several types of dimming controls were analyzed. New results from Norway and Switzerland will shortly be added to the final project report.

The life cycle analysis of products to indicate and assess environmental and other impacts over the lifetime of a product is a relatively new and evolving technique. The means of determining system boundaries and other parameters is not universally agreed on. In this study the life cycles of materials have been outlined and some key aspects identified. Issues including procurement, materials processing, manufacture and assembly, installation, use and maintenance, removal, reprocessing, reuse/recycling and disposal are addressed. Where possible quantitative data have been used. And, embodied energy and carbon dioxide emission levels for different window types are reported on. The work provides an important first step in addressing issues in this area.

A relational database has been set up to process all results arising from the Task. The database categorizes each glazing, identifies the samples distributed, the laboratories receiving them, the measurements that they perform, and the results obtained. These results can be analyzed by glazing, sample, laboratory, country, measurement, etc., and the results can be further processed. The database also contains a directory of participants, addresses, the Task 18 glossary of glazing terms, technology summaries, and the Task Information Plan. It will serve as a basis for disseminating information on the results of the Task to a wider audience.

A teaching and learning packages for the training of architects, design engineers and members of the glass and glazing industry has been prepared and a video which draws the attention of a range of end users to the work of Task 18 is now in the final stages of production.

Subtask B: Case Study Projects

All physical measurements on candidate materials for use in insulating glazing units were successfully completed. Optical, thermal, and mechanical testing of monolithic aerogel samples were completed. Changes to the production process have resulted in aerogels with significantly less visible scattering and improved optical quality. Prototype monolithic aerogel glazings were assembled and distributed by Denmark. Initial results indicate a measured total energy transmittance above 0.75 and a U-value of 0.5 W. m-2. K-1 has been achieved.

A working document on the optical and thermal properties of transparent insulation materials and glazings was drafted and distributed together with a document on the durability and long-term performance of TI-materials and TI-facades.

Detailed modeling of the heat transfer in vacuum windows was undertaken and predicted results compared to experimental results. A number of models have been investigated and results from the single pillar model applied to the unit cell with a periodic function gives good results and acceptable computing time. The work has shown that computer-based simulations, verified by experimental procedures, can give accurate results when examining complex glazing systems.

All results on the commercial switchable glazing samples provided by industry are now complete and reported on. These include the Asahi tungsten oxide-nickel oxide electrochromic device, the Gentex organic electrochromic device, the 3M polymer dispersed liquid crystal device (PDLC), and the BASF/Interpane thermotropic hydrogel device.

The energy and daylight performance of commercial and residential buildings employing switchable devices in different glazing combinations have been modeled by the USA, Norway, Germany and Italy. Electrochromic control strategies analyzed for cooling energy performance were based on incident total solar radiation, space cooling load and outside air temperature. USA results show that an electrochromic material with a high reflectance in the colored state provides the best performance for all control strategies. Switching using space cooling load provides the best performance for all electrochromics. Electrochromics compare favorably to conventional low-e clear glazings with high total energy transmittance that are used with overhangs. Low-e tinted glazings can outperform certain electrochromics. For thermotropic glazing, the total heating and cooling load is 10-20% lower than for static glazing for all parameter variations considered. The results indicate the significant potential for enhanced energy performance and visual comfort in certain climates.

Simulation studies were carried out using a modified version of DOE-2.1E to investigate the energy performance of a selective angular transmittance glazing in a commercial office building in a cooling-dominated climate. The angular selective glazing had varying solar and visible transmittance properties, determined by experimental measurement, which were functions of the solar radiation incident angle. The results show that the cooling energy performance of the angular selective glazing could be improved by deposition on a low-emittance substrate since the solar transmission characteristics of the glazing were too high for the chosen climate. Daylighting energy performance is good because of the high visible transmittance. New coatings, deposited on low-e substrates to cut the NIR transmittance, have subsequently been prepared and experimentally characterized.

Work in the project focused on frame and edge seal technology made very good progress. A study compared the results of simulation and measurement of the U-value for a range of insulated glazings employing different frame designs and materials. The results are extremely encouraging. Overall there is little discrepancy between measurement and calculation. The maximum difference observed is 6% while most differences lie between 2-3%. Measurements were performed to national and international standard procedures and the FRAME programme used for simulations. The results confirm the potential for calculation-based performance assessment for some advanced window types.

Design guidelines for frame and edge seal technology were prepared. The work builds upon the state-of-the-art survey previously completed and presents a comprehensive set of guidelines for the design of low conductive frames and edge seals. The report describes the definition of window U-value; the properties and construction of wood, vinyl and aluminum frames; spacers and sealants for evacuated, aerogel and transparent insulation glazing units; the influence of glazed to total window area on window U-value; interior surface temperature and the effect on U-value of location of the window in the wall construction. A summary of the controlling resistance for principal frame materials is presented together with descriptions of all major frame simulation tools.

The spectral optical properties, directional characteristics, and scattering behavior of all samples provided by the Subtask B materials projects were completed. Two inter-laboratory comparisons were also completed: one on directional reflectance and transmittance of low-e coatings and the second on the diffuse transmittance of a scattering thin film. The latter was presented at the Optical Materials Technology conference held in Freiburg, Germany, in conjunction with ISES EuroSun '96.

A report reviewing the experimental facilities and test procedures employed by the participants for determination of the total solar energy transmittance (TSET) was finalized. The two main approaches to measurement of TSET are direct calorimetric measurement of solar and thermal gains (both indoor and outdoor techniques are described) and the component method where optical measurements of transmittance, reflectance and absorptance of individual component layers are performed with large integrating spheres, thermal resistances are measured and the results are combined by calculation to give TSET. The present relevant ISO document (ISO 9050) describes the methodology for determination of TSET for a very limited class of glazings, namely multiple glazings using only non-diffusing transparent materials with no transmittance for thermal radiation. The working document addresses techniques necessary for angular dependence, the presence of diffusing layers, large glazing thickness, macroscopic structures or patters, air permeability and IR-transparency and time variable properties for many complex glazing systems, e.g. those utilizing integrated louvers, redirectional properties, variable transmission chromogenic windows etc. The work is an important step forward in developing improved test methods for the determination of the principal energy gain coefficient for advanced glazing systems and enables comparison of available test methods.

The directional-hemispherical transmittance of two double glazed units respectively employing one semiconducting heat mirror coating and one multilayered silver-based solar gain control low-e coating were performed by seven laboratories. The samples, provided by Pilkington and Interpane respectively, have previously been characterized in small sample size. Results have been obtained using quite different measurement techniques and differences of some 5-6% are evident in the data. Broadband results are compared to spectral results. A range of sources and detectors have been employed. Further work is in progress to quantify and reduce sources of error.

Glastec '96

The Task 18 exhibition stand at Glastec'96

Following on from the success of the Window Innovations '95 Conference held in Toronto, Canada in June 1995 and the strong, positive interactions with the glass and glazings industry which resulted, Task 18 prepared an exhibition for the Glastec '96 trade fair held in Dusseldorf, Germany, in October 1996. The stand included a display of posters spanning the Task's work and ten advanced glazing units which included low U-value xenon-filled glazing units supplied by Interpane, Germany, and glazings with integrated blinds from Okalux, Germany. The Task built a 1 x 1 m2 prototype evacuated window employing the University of Sydney glazing in a wooden frame designed and built in Norway. The Operating Agent delivered an invited plenary lecture describing the work of Task 18 in the Visions of Glass Symposium held as part of the exhibition.

The Operating Agent also described some of the Task results in the area of insulating glazing units and frame and edge seal technology in an oral paper presented in a plenary session of the EU Berlin Conference Solar Energy in Architecture and Urban Planning.

WORK PLANNED FOR 1997

Three technical reports are now in preparation and will be published in 1997. These reports represent the final written outcomes of Task 18. The three reports are:

- Subtask A Report (T18/STA/FR1/97). This technical report will describe the work of the five projects undertaken in Subtask A examining applications, characteristics, modeling tools, control strategies, results of simulation studies, energy and environmental impacts, and forms of applications guidance.
- The Measurement and Testing Report (T18/STB/FR2/97). This technical report will present results of the measurements of the key glazing performance parameters, total solar energy transmittance, U-value, and directional optical properties. The report will also contain draft recommended test procedures for such measurements.
- The Advanced Glazing Materials and Technologies Report (T18/STB/FR3/97). This technical report on advanced glazing materials and technologies will report on the results and findings from the materials case studies and discuss window design and construction considerations, taking the work of the B9 frame and edge seal technology project. The report will also be supported by an electronic database of the properties of glazing materials and windows as determined by the Task's work.

Further details of these reports can be obtained from the Operating Agent.

WORKING DOCUMENTS PUBLISHED IN 1996

A full list of published working documents is in the Task 18 Information Plan which may be obtained from the Office of the Operating Agent on request.

1996 MEETINGS

Eighth Experts Meeting
February 26-March 1
Thun, Switzerland

Ninth Experts Meeting
September 23-27
Rome, Italy

1997 MEETINGS

Tenth and final Experts Meeting
March 10-14, 1997
Nagoya, Japan.

An Industry Workshop will be held in Nagoya on March 12, 1997 with associated conference proceedings being published.

TASK 18 NATIONAL CONTACT PERSONS

Operating Agent

Prof. Michael Hutchins
Solar Energy Materials Research Laboratory
School of Engineering
Oxford Brookes University
Gipsy Lane
Headington
Oxford OX3 0BP
United Kingdom

Australia

Prof. John Ballinger (Subtask A Leader)
University of New South Wales
PO Box 1
Kensington
NSW 2033

Canada

Jeff Baker
Enermodal Engineering Limited
368 Phillip Street
Waterloo N2L 5J1
Ontario

Denmark

Prof. Svend Svendsen
Thermal Insulation Laboratory
Technical University of Denmark
Building 118
DK-2800 Lyngby

Finland

Dr. Markku Virtanen
Technical Research Centre of Finland
Laboratory of Heating & Ventilation
Lampomiehenkuja
PO Box 206
FIN-02150 Espoo

France

Dr. Jean-Luc Chevalier
C.S.T.B.
24 rue Joseph Fourier
F-38400 Saint-Martin d'Heres

Germany

Dr. Werner Platzer
Fraunhofer-Institut
für Solare Energiesysteme (ISE)
Oltmannsstr 22
7800 Freiburg

Italy

Augusto Maccari
ENEA
V. Anguillarese, 301
00060 S Maria di Galeria
Rome

Japan

Dr. Sakae Tanemura
Government Industrial Research Institute Nagoya
1-1 Hirate-Cho
Kita-Ku
Nagoya 462

Netherlands

Aart de Geus
TNO Building and Construction Research
Department of Indoor Environment
Building Physics and Systems

PO Box 29
2600 AA Delft

Norway

Prof. Øyvind Aschehoug (Subtask B Leader)
Department of Architecture
Norwegian Institute of Technology
N-7034 Trondheim

Spain

Manuel Macias
CIEMAT-IER
Avda. Complutense, 22
28040 Madrid

Sweden

Dr. Arne Roos
Department of Technology
University of Uppsala
PO Box 534
S 751 21 Uppsala

Switzerland

Thomas Nussbaumer
Swiss Federal Laboratories for Materials Testing & Research
Überlandstr 129
8600 Dübendorf

United States

Sam Taylor
US Department of Energy
Office Building Technology, CE 421
Room 5E 098
Washington, DC 20585

Task 19: Solar Air Systems

S. Robert Hastings
ETH-Zürich
Operating Agent for the Swiss Federal Office of Energy

TASK DESCRIPTION

Solar air systems have unique advantages for space heating and tempering ventilation air. Air, unlike water, needs no freeze protection. Nor are leaks damaging to the building structure or its contents. In contrast to passive systems, active air systems provide better heat distribution and hence improved comfort and fuller use of solar gains. Solar air systems are a natural fit to mechanically ventilated buildings and mechanical ventilation is increasingly common, not only in commercial and institutional buildings, but also in very low energy residences.

The economics of air systems improve when they serve additional uses, such as admitting daylight, inducing cooling, providing sunshading, generating electricity, or preheating domestic hot water. They may also have non-energy functions, such as providing a usable zone, a load bearing element, weather protection, or a barrier to street noise.

Unfortunately, designers lack experience in planning, analyzing and constructing such systems. Furthermore, documentation of built prototypes to convince building clients is scarce. The two Subtasks of Task 19 address these needs:

Subtask A: Generic Systems

- Components to be tested and documented in collaboration with industry.
- A computer tool to be developed to model the recommended systems.
- A design handbook to be written to help engineer solar air systems.

Subtask B: Building Applications

- Exemplary buildings with solar air systems to be monitored.
- Design reviews of new building projects to be carried out.
- A book documenting exemplary buildings with solar air systems to be produced.

ACTIVITIES DURING 1996

The following work was completed:

- Laboratory testing of solar air collectors was begun, with Grammar being the first collector tested.

During the presentation of the test procedure at the September Experts Meeting in Canada questions were raised and suggestions made. The test procedure reflects the latest developments towards an international standard. Four additional manufacturers have expressed interest to have their collectors tested.

- Level 1 of Transair [1], a TRNSYS-based program with an easy to use Windows interface, has been completed for all six solar air system types of Task 19, tested by the experts and revised per their feedback. The current version incorporates a reference house for testing the effectiveness of system variations in four different types of climate.
- The reference building types for carrying out the parametric studies have been redefined based on a review of the buildings and construction typical in the participating countries. The range of heat loss coefficients has been increased for the residential unit to cover existing, poorly insulated buildings. Retrofitting existing buildings is an important target application. The office building has been substituted by a large volume, low internal gain building because the latter has greater potential for solar air applications. Examples of this building type include athletic halls, buildings for light manufacturing, and warehouses.
- Mock-ups of nomograms based on pilot sensitivity studies, carried out at the University of Siegen, have allowed various graphic presentation approaches to be tested for the handbook. A method of characterizing climates has been invented. If it proves successful, it will allow engineers to correlate the climate of a specific project location to the climate types in the handbook and possibly fine tune the results. Finally, construction details for several of the systems have been drafted for the respective chapters.
- Monitoring of all the case studies has been completed. Twenty-eight case studies of houses, apartment buildings, schools, sports halls, and light industry buildings with innovative solar air systems throughout diverse climates in North America and Europe have been completed by the experts and submitted to the Operating Agent for final editorial review. Figures 1 and 2 illustrate one of the Task 19 houses with a roof integrated solar air collector leaving the south facade free for generous windows and a sunspace to profit from passive solar gains.

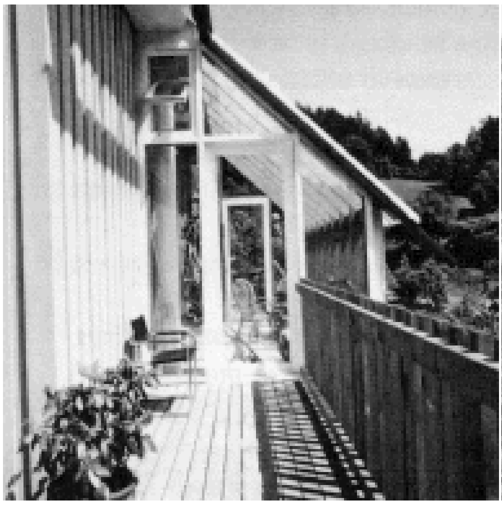


Figure 1

Figure 2

Due to the late date of availability of the computer models and to revisions to the reference building types, work on the parametric studies and subsequently completion of the handbook are behind schedule. For these reasons, the experts requested an 18 month Task extension. This extension was approved at the October meeting of the Executive Committee.

WORK PLANNED FOR 1997

- Additional collectors will be provided by industry and tested at the Arsenal facilities in Vienna. Task 19 will cooperate with international standards organizations in developing standard test procedures for solar air collectors.
- Confidence checks of the TRANSAIR systems models will be made by the experts. This will involve

testing the reasonableness of results by running parameter variations, making rough comparisons to monitored case studies and running checks with other dynamic models. Level 2 of the Task 19 PC tool will be completed for test use by the end of the year.

- Parametric studies using the PC tool and the new reference buildings will be begin in order to produce the graphs to be used as a basis for the final nomograms in the engineering handbook. Subchapters of the systems and components (i.e., construction details) will be further developed.
- The case studies will be edited for completeness, consistency of key statistics, and technical level for the architect readership. The graphics will be redrafted. This work is now the responsibility of the Operating Agent.
- Product sheets for the Catalog of Manufactured Products will be collected and reviewed. Publication of this catalog now depends on industry interest.

LINKS WITH INDUSTRY

Manufacturers

Two manufacturers of solar air collectors from Norway and Germany have funded work in Task 19 and three other firms from Austria, Denmark, and Switzerland have been involved with the case studies and products catalog.

Architects and Consulting Engineers

Three architects from firms engaged in constructing solar air heated buildings in Austria, Norway, and Sweden are participating as Task experts. Consulting engineers with active involvement in building projects are also participating in the Task including experts from Austria, Canada, Germany, and Switzerland. Hence, a link is provided between what the Task is producing and what is needed to actually plan buildings with solar air systems.

PUBLICATIONS PLANNED FOR 1997

The book of case studies is scheduled to be published in 1997. Negotiations with James & James Science Publishers of the UK are in progress. The Catalogue of Components may be distributed as a supplement to this book, depending on manufacturer interest in providing the product sheets.

1996 MEETINGS

Sixth Experts Meeting
April 15-17
Stratford upon Avon, United Kingdom

Attended by 22 experts from nine countries.

Seventh Experts Meeting
September 30-October 4
Pary Sound, Canada

The meeting included a PC workshop and a tour of a solar wall project.
Attended by 21 experts from nine countries.

Handbook working group meeting
December 11

Stuttgart, Germany

Attended by 10 experts from Denmark, Germany and Switzerland.

1997 MEETINGS

Eighth Experts Meeting
April 6-9
Bregenz, Austria

Ninth Experts Meeting
September
Scandinavian location to be determined.

TASK 19 NATIONAL CONTACT PERSONS

Operating Agent

S. Robert Hastings
Solararchitektur
ETH-Hönggerberg
CH-8093 Zürich
Switzerland

Austria

Manfred Bruck
Kanzlei Dr. Bruck
Garnisongasse 7
A 1090 Vienna

Sture Larson
Architekt
Lindauerstr. 33
A 6912 Horbranz

Eckhard Drössler
Energiesparverein
Postfach 51
A 6851 Dornbirn

Hubert Fechner
Dept. Refrig. Engineering
Bundesforschungs- und Pruf.
Fardaygasse 3
A 1031 Wien

Canada

John C. Hollick
Conserval System Inc.

200 Wildcat Road
Downsview
Ontario M3J 2N5

Denmark

Ove Morck
Cenergia APs
Sct. Jacobs Vej 4
DK 2750 Ballerup

Søren Ostergaard Jensen
Solar Energy Laboratory
Danish Tech. Institute
DK 2630 Taastrup

Finn Kristiansen
Technical Univ. of DK
Building 118
DK 2800 Lyngby

Germany

Matthias Schuler
Transsolar
Nobelstr. 15
D 70569 Stuttgart

Frank D. Heidt
Fachbereich Physik
Universität GH Siegen
D-5900 Siegen

Jochim Morhenne
Büro für Umweltverträgl.
Schülkestrasse 10
D 42277 Wuppertal

Hans Erhorn
Fraunhfer Inst.für Bauphysik
Nobelstrasse 12
D 70569 Stuttgart

Siegfried Schröpf
Grammer AKG
Werner von Braun Str. 6
D 92224 Amberg

Italy

Gianni Scudo
DPPPE Politec.di Milano

Via Bonardi
I 20133 Milano

Norway

Harold Rostvik
Sunlab / ABB
Steingt 87
N 4024 Stavanger

Sweden

Torbjörn Jilarv
Swed. Univ. of Agriculture
Dept. of Farm Buildings
S23053 Alnarpv

Christer Nordström
Architektkontor
Asstigen 14
S 43645 Askim

Switzerland

Charles Filleux
Basler & Hofmann
Forchstr. 395
CH 8029 Zürich

Karel Fort
Postfach 2111
Weiherweg 19
CH 8604 Volketswil

United Kingdom

Kevin Lomas
School of Built Environment
De Montfort University
Lester LE1-9BH

1

Level 0: System selection: system energy performance computed for two fixed buildings in five constructions in four climates. Results will provide nomograms to help with system selection.

Level 1: System configuration can be varied to see how performance is affected for the above building, constructions, and climates.

Level 2: Components are analyzed, varying component parameters.

Level 3: Building, system, and components can be individually specified.

PREVIOUS CONTENTS NEXT

Task 20: Solar Energy in Building Renovation

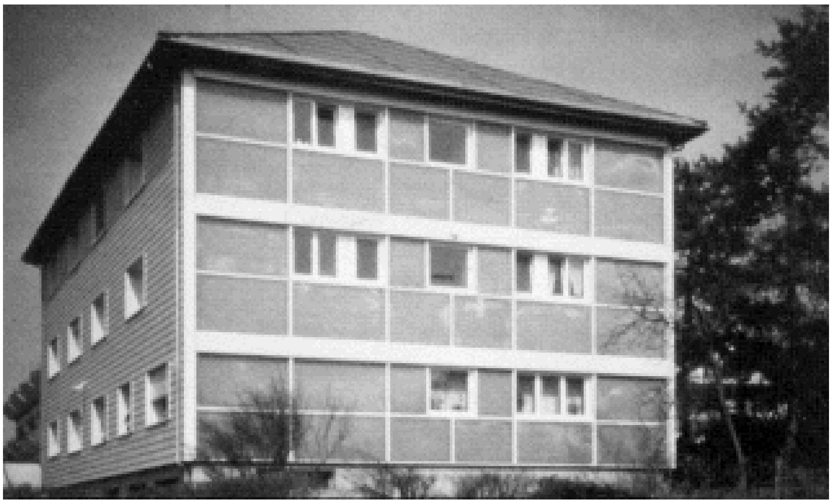
Prof. Arne Elmroth
Lund University
Operating Agent for the Swedish Council for Building Research

TASK DESCRIPTION

Task 20, Solar Energy in Building Renovation, is the first IEA SHC Task to focus specifically on the use of solar energy in existing buildings. The objective of the Task is to increase the utilization of solar energy in existing buildings by developing strategies for effectively and economically integrating widely-applicable solar designs and concepts in the renovation process. This includes compiling guidelines needed by designers and remodelers, and developing strategies to reach key players in the renovation process to obtain their support and provide them with needed information on solar opportunities.

Before renovation

Renovation or remodeling can be motivated by a variety of needs, including a desire to repair or replace a leaking roof, a deteriorated concrete balcony, or poor windows; increase living or work space area; upgrade the building's appearance; improve indoor comfort levels; improve daylight usage; reduce utility expenses; or accommodate changes in building use. Regardless of the reason, renovation presents special challenges and opportunities for applying different solar energy strategies.



After renovation

This multifamily house in Hedingen, Switzerland, was renovated with prefabricated transparent insulation on the south and west facades in order to reduce energy damand, improve comfort, reduce moisture problems, and comply with clean air regulations. Together with traditional insulation, improved windows, and solar collectors for domestic hot water this renovation reduced fuel requirements by 70%. Solar technology contributed 28% of the reduction

Task 20 is divided into four Subtasks, each coordinated by a lead country:

Subtask A: Evaluation of Existing Building Applications (Sweden)

This Subtask has focused on obtaining as much relevant information as possible from existing solar renovation projects--both positive and negative. Information was collected on the reasons for renovation, various features employed, the renovation process, and occupants' reactions.

Subtask B: Development of Improved/Advanced Renovation Concepts (Belgium)

The main focus of the Subtask is the development of improved and advanced renovation concepts. A wide variety of possible systems, components, and strategies have been identified and analyzed in specific renovation situations to assess their feasibility and performance.

Subtask C: Design of Solar Renovation Projects (Denmark)

Subtask activities are divided into two areas: the design of solar renovation projects and the evaluation of solar renovation projects. Subtask participants have created designs for solar renovation demonstration projects and developed monitoring procedures and reporting formats.

Subtask D: Documentation and Dissemination (Netherlands)

Under this Subtask, the results of the Task are summarized and documented. Various information dissemination methods are being used. The Subtask consists of the following elements:

- The document Solar Renovation Strategies and Lessons Learned
- Arrangement and Participation in interna- tional symposia
- Compilation of illustrative source materials
- National dissemination of Task results

Task 20 was initiated on August 1, 1993 and scheduled to run until December 31, 1996. However, a two-year extension was approved by the Executive Committee and therefore the Task will continue until December 31, 1998.

ACTIVITIES DURING 1996

Two Experts Meetings and two extra meetings were held in 1996. The participating countries are involved in all four Subtasks with the same Experts, except Belgium and the USA, who did not contribute to Subtask A.

Subtask A: Evaluation of Existing Building Applications

Subtask A has been completed and no new activities were undertaken in 1996. A summary of these results were published in the journal *Energy and Buildings*.

Subtask B: Development of Improved/Advanced Renovation Concepts

During this year, work was conducted on the publication *Improved Solar Renovation Concepts* which is to be complete in 1997. This international guide includes three parts starting with a section of tables to illustrate the applicability of different solar renovation strategies and concepts of four basic building types: houses, apartments, schools, and offices. The next section presents the simulation work results of the most relevant concepts which were carried out by the participating countries. (See Table 1.)

The report ends with conclusions and basic market conditions for each concept, including the main characteristics of the existing products, their situation on the building market, and the financial, practical and constructive aspects.

TABLE 1.
Simulations conducted by each country and the different solar concepts as reported in *Improved Solar Renovation Concepts*

	Single family houses	Residential houses	Offices	Schools, department stores, industries
Glazed Balcony		Switzerland(CH) Denmark(DK) Netherlands(NL)		
Transparent insulation		Switzerland(CH) Germany(D) Denmark(DK)		
Roof window, light core	Belgium(B)	Belgium(B)		United States(US)
Solar walls		Denmark(DK)		
Second skin facade				Switzerland(CH)
Unglazed transpired collector				United States(US)
PV		Denmark(DK)		
Solar collectors		Sweden(S)		

Subtask C: Design of Solar Renovation Projects

The experiences of designing 16 demonstration projects are reported in the document Solar Renovation Demonstration Projects. The different projects and concepts in the respective countries are shown in Table 2.

The report includes design and evaluation methodology, and design reports for each project. It is to be completed in early 1997.

TABLE 2. Solar Renovation Demonstration Projects		
Project Title	**Building Type**	**Solar Technologies**
B, Roof window in row house	Residential	Light cores for daylight, attached sun space.
B, Roof window in high housing	Residential	Glazed balconies and galleries, Light cores for daylight.
CH, Affolternstrasse	Residential	Transparent insulation (TI), TI walls. Roof integrated solar collector, domestic hot water (DHW).
CH, Brugghof	Residential	TI walls. PV-systems.
CH, Valency	Residential	TI walls.
CH, Wollerau	Residential	TI walls.
CH, Technical School Lucerne	School	Glazed second skin facade.
D, "Villa Tannheim"	Office	Low cost TI walls. Roof integrated solar collector (DHW).
D, Salzgitter	Factory	TI for thermal insulation and improved daylighting.
DK, The Yellow House	Residential	Roof integrated solar collector (DHW). Glazed balconies. Ventilated solar walls for preheating ventilation air, PV-systems.
NL, Brandaris	Residential	Roof integrated solar collector (DHW). Glazed balconies.
NL, Hoog Zandveld	Residential	Roof integrated solar collector (DHW). Glazed balconies.
S, Onsala	Residential	Roof integrated solar collector (DHW).
S, Rannebergen	Residential	Roof integrated solar air coll. Ventilated/unventilated solar walls.
S, Västra Gårdstensbergen	Residential	Roof integrated solar collector (DHW).
US, Thomas Stone High School	School	Air collectors for preheating ventilation air, daylight, solar pool heating.

Subtask D: Documentation and Dissemination

To be able to reach a wider audience, the results from Subtasks A, B and C have been compiled into four brochures. An overview brochure, Solar Energy in Building Renovation, provides an introduction to solar energy in building renovation. The three other brochures describe more in-depth different solar concepts. Their titles are Building Integrated Solar Collectors, Glazed Balconies in Building Renovation, and Transparent Insulation in Building Renovation. Each brochure is 16 pages and can easily be put in one binder. They will be published by James & James Science Publishers Ltd, London in 1997.

Task 20 results were presented at the following international conferences. And, special Task workshops were held at the PLEA and EuroSun '96 conferences.

- EU Conference on Solar Energy in Architecture and Urban Planning Berlin, Germany in March 1996
- PLEA (Passive Low Energy Architects) Brussels, Belgium in July 1996
- Nordic Building Physics Symposium Espoo, Finland in September 1996
- EuroSun '96 (ISES) Freiburg, Germany in September 1996

WORK PLANNED FOR 1997

- The publication of several Task reports during the winter of 1996/1997.

- Work will begin under the Task extension focusing on the application of solar energy technologies for space and domestic water heating, and lighting in existing residential and non-residential buildings. The Task extension will emphasize:

  -International exchange of knowledge on technologies, by monitoring and evaluating the energy performance of the demonstration projects and the renovation process.
  -Improving selected solar concepts and systems for building renovation.
  -Disseminating results and market feedback.

  And, will include three new Subtasks:

  Subtask E: Evaluation of Demonstration Projects
  Subtask F: Improvement of Solar Renovation Concepts and Systems
  Subtask G: Dissemination of Results

LINKS WITH INDUSTRY

For the direct work as Expert in the Task, there was one representative from the manufacturing industry: TI wall and glazing elements manufacturer (Ernst Schweizer AG, Switzerland). From the engineering consultants companies there were two representatives in the Task.

By a close cooperation between researchers and industry (Derome AB) a roof-integrated solar collector has been developed and produced.

REPORTS PUBLISHED IN 1996

"Solar Energy in Building Renovation" in the *Energy and Buildings Journal*, Volume 24 (1996), pp 39-50.

REPORTS PLANNED FOR 1997

Improved Solar Renovation Concepts (Subtask B Report). This report can be ordered from A. De Herde (see Task participant list at end of chapter for address).

Solar Renovation Demonstration Projects (Subtask C Technical Report). This report is available from Esbensen Consulting Engineers, FIDIC, Teknikerbyen 38, DK-2830 Virum, Denmark, Fax:+45-45 83 68 34, e-mail: esbensen@inet.uni-c.dk

Solar Energy In Building Renovation (Brochure)

Building Integrated Solar Collectors (Brochure)

Glazed Balconies in Building Renovation (Brochure)

Transparent Insulation in Building Renovation (Brochure)

The above brochures will be available in early 1997 from James & James Science Publishers Ltd, London, United Kingdom.

1996 MEETINGS

Sixth Experts Meeting

February 12-14
Waterloo, Canada

Extra Meeting
March 28
Berlin, Germany

Seventh Experts Meeting
June 10 - 12
Boulder, Colorado, USA

Extra Meeting
September 19 - 20
Freiburg, Germany

1997 MEETINGS

To be determined.

TASK 20 NATIONAL CONTACT PERSONS

Operating Agent

Arne Elmroth
Lund University
Dept. of Building Physics
P.O.Box 118
S-221 00 Lund
Sweden

Operating Agent Assistant

Elisabeth Kjellsson

Belgium

André De Herde
Centre de Recherche en Architecture
Universite Catholique de Lovain
Place de Levant 1
B-1348 Lovain-La-Neuve

Denmark

Olaf Bruun Jørgensen
Esbensen Consulting Engineers
Teknikerbyen 38
DK-2830 Virum

Germany

Karsten Voss
Fraunhofer Inst. for Solar Energy Systems
Oltmannsstrasse 5
D-79100 Freiburg

Netherlands

Chiel Boonstra
Woon/Energie
P.O.Box 733
NL-2800 AS Gouda

Sweden

Jan-Olof Dalenbäck
Chalmers University of Technology
Aschebergsgatan 55
S-411 33 Göteborg

Switzerland

Andreas Haller
E.Schweizer AG, Metallbau
CH-8908 Hedingen

United States

Robert T. Lorand
Science Applications Int. Corp.
MS 2-7-2
1710 Goodridge Drive
McLean, Virginia 22102

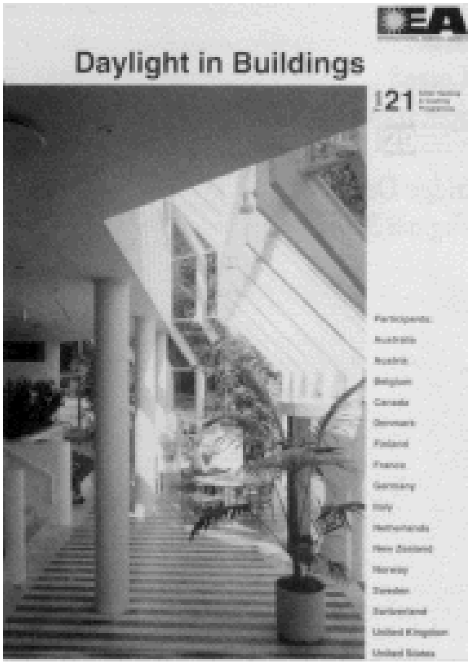
PREVIOUS CONTENTS NEXT

Task 21: Daylight In Buildings

Kjeld Johnsen
Danish Building Research Institute
Operating Agent for the Danish Energy Agency

TASK DESCRIPTION

Artificial lighting represents a major part of the overall energy consumption in non-residential buildings. However, more daylight conscious architectural solutions and the introduction of innovative daylighting systems and efficient lighting controls could displace a considerable part of this electricity consumption by utilising the natural resources offered by daylight. Furthermore, it is generally recognized today that the design of the fenestration system and the proper use of daylight in building interiors are important factors, both for the conservation of non-renewable fuels and for the well-being of occupants.



This brochure outlines the work to be completed under SHC Task 21 and BCS Annex 29

However, a number of barriers hinder appropriate integration of daylighting aspects in the building design. One is the lack of documented, empirical evidence that daylighting can substantially improve energy efficiency and visual quality in buildings. Furthermore there is insufficient knowledge and lack of information on new fenestration technologies and lighting control systems and the ability of such systems to enhance utilization of daylight, and a lack of user friendly daylighting design tools and models for innovative daylighting systems.

Task 21 will contribute to the overcoming of the identified barriers. The Task was initiated in 1995 with the main objectives to advance daylighting technologies and to promote daylight conscious building design. Through selected Case Studies the Task will demonstrate the viability of daylighting designs under various climatic conditions emphasizing system performance regarding energy savings and user acceptability.

The main deliverables from the Task will be:

- A system specific *Design Guide* on daylighting systems and control systems providing recommendations on systems integration and performance data on energy saving potentials.
- A set of *Daylighting Design Tools* that will markedly improve the designers' ability to predict the performance of daylighting systems and control strategies and to evaluate the impact of daylight integration in the overall design concept.
- A *Case Studies Report*, documenting measured data on daylighting performance, energy consumptions and user appraisal of the environmental conditions.

The work of the Task is structured in the following four Subtasks:

Subtask A: Performance Evaluation of Daylighting Systems (Australia)

This Subtask will provide design guidance on the performance of both innovative and conventional daylighting systems. Systems will be assessed according to energy saving potential, visual aspects and the control of solar radiation. The evaluation of systems is to be based not only on technical feasibility but also on architectural and environmental impacts.

Subtask B: Daylight Responsive Lighting Control Systems (Netherlands)

Energy savings from daylighting cannot be significant without an appropriate integration of window design and electrical lighting systems. The objectives of Subtask B are to evaluate the performance of existing selected daylight responsive lighting control systems (in conjunction with selected daylighting systems) in terms of their capability to control the artificial lighting in response to available daylight and in terms of user acceptance of the systems. This will assist building owners, developers, architects, and engineers to select and commission daylighting responsive systems, and to estimate the potential energy savings at an early stage of design.

Subtask C: Daylighting Design Tools (Germany)

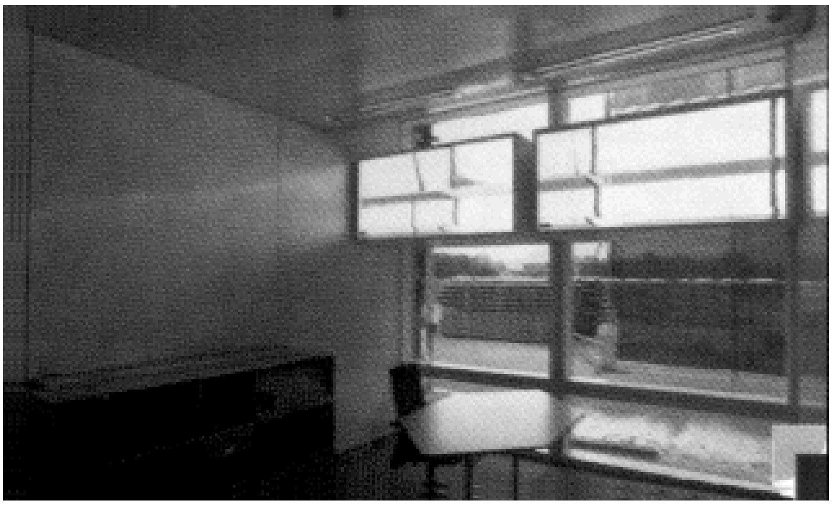
The objective of Subtask C is to improve the capability, accuracy and ease-of-use of daylighting design and analysis tools for building design practitioners, covering all phases of the design process. The practitioners will be able to predict the performance of different daylighting systems and control strategies and to evaluate the impact of the integration of daylighting in the overall building energy concept by using these design tools.

Subtask D: Case Studies (Denmark)

Despite claims that daylighting can substantially improve visual quality and energy efficiency of buildings, there is little documented empirical evidence. The main objective of Subtask D is to demonstrate the viability of daylighting buildings in various world climate zones as an energy saving potential in buildings while maintaining a satisfactory visual and thermal environment for occupants, and to provide real validation data to computer models.

ACTIVITIES DURING 1996

Task 21 addresses important aspects of the utilisation of natural light in non-residential buildings. The Task focuses on both innovative and conventional daylighting strategies which can be applied in new and existing buildings with a high aggregate electricity saving potential such as offices, schools, commercial, and institutional buildings. The work encompasses establishment of fundamental procedures for testing and performance evaluation of daylighting systems and lighting control strategies, development of simplified tools and advanced computer models for design and analysis of the lighting environment, and demonstration through case study buildings that daylight conscious design



A testroom with an anidolic daylighting system at LESO, Ecole Polytechnique Federale de Lausanne, Switzerland can significantly improve the energy efficiency and the visual environment of the occupants.

In 1996, the Task made good progress with much time dedicated to thorough preparation of the procedures for testing and performance assessment of systems in test rooms and real buildings. Two experts meetings were held, one in San Francisco, California, USA at the Lawrence Berkeley National Laboratories and one in Lyon, France at the Ecole Nationale des Travaux Publics de l'Etat. An overview of the work in progress and the achievement of the past year is given below.

Subtask A: Performance Evaluation of Daylighting Systems

The planned use of natural lighting in non-residential buildings is today one of most commonly noted strategies to minimise lighting heating and cooling loads. Subtask A is developing recognised procedures for testing and evaluating the performance of daylighting systems and devices in various climatic zones, entailing international collaboration.

In the past year, seven countries were actively involved in the development of procedures for detailed laboratory testing of component properties, such as total transmission and bi-directional light transmission functions, and procedures for system performance assessment in test rooms. Several working documents on the procedures have been prepared and the first pilot studies on the evaluation and necessary adjustments to the procedures have been conducted. The most important documents are:

- *Innovative Daylighting System Survey* (1st draft) includes preliminary technical descriptions of some 20 different systems, and covers physical principles, practical application, design considerations, and more.
- *Physical Quantities to be Measured in Laboratory Facilities* (1st draft) identifies the physical quantities to be measured and principles of measurements.
- Two draft documents, *Bi-directional Measurements - Principles and Data*, give the procedures for measurement of systems' physical characteristics by a goniophotometer. Among the first systems measured and used for evaluation of the procedures were a prismatic films and a Lambertian diffuser.

Subtask B: Daylight Responsive Lighting Control Systems

Daylight energy saving potentials are realised by dimming or switching off electric lights when there is sufficient natural light. Because daylight availability coincides with normal working hours and building peak power, daylighting can significantly lower electricity charges. The dynamic nature of daylight and introduction of innovative daylighting systems which redirect or change the daylight penetration put heavy demands on the lighting controls. Subtask B is producing guidance on design and evaluation of daylight responsive lighting control systems, and documenting monitored performance of the selected systems.

The Subtask B work has been focused on the development and completion of a database of lighting control systems from which the participating institutions have selected the systems to be tested. A detailed monitoring protocol has been developed for the testing and evaluation of the system's ability to control the artificial light as a function of daylight availability. The first pilot studies also were conducted for the necessary adjustments of the protocol, before the official testing began at the end of 1996. The most important outcome of the past year were the following documents/results:

- *Database of Daylight Responsive Lighting Control Systems* (final version of structure) includes manufacturers, complete control systems (name, manufacturer, user interface, technical features, etc.), components for control systems, and bus-systems. The database will be regularly updated until the end of 1999.
- *Monitoring Protocol for Performance Evaluation of Control Systems in Test Rooms* (1st draft) includes minimum evaluation procedures and possible extension with monitoring and user

assessment. The procedures will be coordinated with those planned for evaluation of daylight systems in Subtask A.

Subtask C: Daylighting Design Tools

One of the identified barriers for integration of daylighting aspects in building design is the lack of appropriate and user friendly daylighting design tools. The activities of Subtask C include assessment of capabilities and accuracy of existing tools, as well as the development and validation of algorithms for daylighting systems and control strategies. The Subtask also secures further development and improvement of the advanced ADELINE program system developed in IEA SHC Task 12 with emphasis on integration with CAD models and energy analysis tools.

In the past year, Subtask C has conducted surveys and established internal information for the World Wide Web site on daylighting tools and algorithms as well as data sets for validation of simplified and advanced tools. The work on daylight model integration with other tools has been based on the Danish concept for a common integrated data model, while the ongoing development of ADELINE resulted in the release of the 2.0 version of this package. The main results were:

- *Electronic Information System on Daylighting Algorithms on WWW* includes general algorithms, simplified and advanced models (accessible for Task participants).
- *Reference List on Validation of Daylighting Tools* serves as information forum on BRE's Web site.
- *Prototype of First Integrated Data Model* includes all geometrical aspects, based on the STEP and the IAI standards for data exchange.
- *Version 2.0 of the ADELINE software package* is significantly improved for user friendliness and documentation.

Subtask D: Case Studies

Through selected case study buildings Task 21 will demonstrate that daylight conscious design can significantly improve energy efficiency and improve the visual and thermal environment for occupants. Subtask D establishes procedures and a monitoring protocol for the assessment of daylight and energy performance of non-domestic buildings. A crucial aspect of innovative daylighting systems is the occupants' appraisal of such systems and the visual conditions. The Subtask will develop procedures to assess the user satisfaction or acceptance of daylighting and lighting control systems in the normal working environment.

The Geyssel office building in Cologne, Germany, is one of the case study buildings. This building has a special daylight guiding system directing sunlight to the ceiling to illuminate rooms using natural daylight without glare and reducing the use of artificial lighting

In the last 12 months, the seven countries participating in Subtask D have focused their work on selection of appropriate Case Studies and development of the monitoring protocol and procedures for user evaluations. The main documents are:

- *Document on Case Studies* (1st draft) includes descriptions of potential case study buildings from different climatic zones of the IEA community. It is expected that around 15 buildings will selected as objects of this research.
- *Monitoring protocol* (2nd draft) documents the common procedures for performance assessment. This document will be of great value in general building performance assessment, and it has been

decided that it will be an official IEA report once approved by the Executive Committee.

- *Document on Assessment of User Acceptability* (2nd draft) describes how to conduct a post occupancy evaluation (POE) with special attention to daylighting and lighting aspects.

WORK PLANNED FOR 1997

Task 21 is now moving into a crucial phase of the work where preparatory work of developing procedures and protocols must stand their trial in practical application. The testing of daylighting systems and control systems in test rooms will start in the beginning of 1997, and the monitoring of many of the case study buildings will begin in the summer.

LINKS WITH INDUSTRY

All Subtasks have significant links to industry, and in many participating countries, industry offers significant financial support for work being undertaken. Most of the daylighting systems and lighting control systems are provided by manufacturers, who naturally have an interest in the Task's testing procedures results. In Subtask B on Control Systems, major manufacturers are directly involved in the research activities and are providing excellent facilities for the testing of several systems and strategies. In Subtask C on Design Tools, the development of a common platform for integration of building design tools is partly based on the standards set by the Industry Alliance for Interoperability (IAI). Subtask D on Case Studies is led by a private engineering consultant and has strong links to a similar project under the European Community's JOULE programme. In this Subtask building owners are making their buildings available for Task monitoring and user evaluations. In some cases, the owners have provided unoccupied spaces for direct full-scale testing.

REPORTS PUBLISHED IN 1996

Only draft reports have been prepared in the past year, some of which however, are now in their second draft versions to be finalized in the first half of 1997.

An important product for the information on the work of this huge project is an 8-page colour brochure of SHC Task 21 (and BCS Annex 29) which was produced and distributed at the end of 1996. The brochure is intended to draw the attention and interest of industry and building design practitioners to this international collaborative effort of 38 institutions of the IEA community.

REPORTS PLANNED FOR 1997

The testing procedures and monitoring protocols will eventually be turned into official IEA reports for the benefit of industry and design practitioners. The following reports are expected to be available by the end of 1997.

Report on Measurements of Physical Quantities of Daylighting Systems and Components in Laboratory Facilities

Monitoring Protocol for Performance Evaluation of Daylighting Systems in Test Rooms

Monitoring Protocol for Performance Evaluation of Control Systems in Test Rooms

Monitoring Protocol for Evaluation of Daylight and Energy Performance of Buildings

1996 MEETINGS

Second Experts Meeting
April 10-13
San Francisco, California, USA

Third Experts Meeting
October 6-9
Lyon, France

1997 MEETINGS

Fourth Experts Meeting
April 21-24
The Netherlands

Fifth Experts Meeting
October 28-31
Brisbane, Australia

TASK 21 NATIONAL CONTACT PERSONS*

Operating Agent

Kjeld Johnsen
Danish Building Research Institute
P.O. Box 119
2970 Hørsholm
Denmark
E-mail: kjj@sbi.dk

Australia

Nancy Ruck (Subtask A Leader)
University of Sydney
Department of Architecture & Design Science
AUS - Sydney NSW 2006

Austria

Martin Klingler
LichtLabor Bartenbach
Rinner Strasse 14
A - 6071 Aldrans

Belgium

André de Herde
Université Catholique de Louvain
Centre de Recherche en Architecture
Place de Levant 1
B - 1348 Louvain-la-Neuve

Canada

Morad Atif National Research Council Canada
Building Performance Laboratory
Ottawa, Ontario K1A OR6

Denmark

Poul E. Kristensen (Subtask D Leader)
Danish Technological Institute
Division of Energy
P.O. Box 141
DK - 2630 Taastrup

Jens Christoffersen
Danish Building Research Institute
P.O. Box 119
DK - 2970 Hørsholm

Germany

Heinrich Kaase
Technische Universität Berlin
Institut für Lichttechnik
Einsteinufer 19
D - 10587 Berlin

Hans Erhorn (Subtask C Leader)
Fraunhofer Institut für Bauphysik
Nobelstrasse 12
D - 70569 Stuttgart

Finland

Liisa Halonen
Helsinki University of Technology
Otakaari 5A
FIN - 02150 Espoo

France

Vincent Berrutto
ENTPE/DGCB
Rue Maurice Audin
F - 69518 Vaulx-en-Velin, Cedex

Italy

Ferdinando Raponi
ENEA, SIRE
Casaccia

I - 00060 S.M. di Galeria, Roma

Netherlands

Laurens Zonneveldt (Subtask B Leader)
TNO-TUE Centre for Building Research
P.O. Box 513
NL - 5600 MB Eindhoven

New Zealand

Michael Donn
Victoria University of Wellington
Centre for Building Performance Lab.
P.O. Box 600
NZ - Wellington 1

Norway

Øyvind Aschehoug
Norwegian University of Science and Technology
Faculty of Architecture
N - 7034 Trondheim

Sweden

Staffan Hygge
K T H, Built Environment
P.O. Box 88
S - 801 02 Gävle

Switzerland

Jean Louis Scartezzini
University of Geneva
LESO-PB, EPFL
CH - 1015 Lausanne

United Kingdom

Maurice Aizlewood
Building Research Establishment
Lighting & Applied Vision Section
Garston
UK - Watford WD2 7JR

United States

William L. Carroll
Lawrence Berkeley Laboratory
Building 90 - 3026

Berkeley, California 94720

* This list includes national contact persons and Subtask leaders. A total of 38 institutions participate in Task 21. For the full address list see the Task 21 Address List.

PREVIOUS CONTENTS NEXT

Task 22: Building Energy Analysis Tools

Michael J. Holtz
Architecture Energy Corporation
Operating Agent for the US Department of Energy

TASK DESCRIPTION

The overall goal of Task 22 is to establish a sound technical basis for analyzing solar, low-energy buildings with available and emerging building energy analysis tools. This goal will be pursued by accomplishing the following objectives:

- Assess the accuracy of available building energy analysis tools in predicting the performance of widely used solar and low-energy concepts;
- Collect and document engineering models of widely used solar and low-energy concepts for use in the next generation building energy analysis tools; and
- Assess and document the impact (value) of improved building energy analysis tools in analyzing solar, low-energy buildings, and widely disseminate research results to tool users, industry associations and government agencies.

Task 22 will investigate the availability and accuracy of building energy analysis tools and engineering models to evaluate the performance of solar and low-energy buildings. The scope of the Task is limited to whole building energy analysis tools, including emerging modular type tools, and to widely used solar and low-energy design concepts. To accomplish the stated goal and objectives, the Participants will carry out research in the framework of two Subtasks:

- Subtask A: Tool Evaluation
- Subtask B: Model Documentation

Tool evaluation activities will include analytical, comparative and empirical methods, with emphasis given to blind empirical validation using measured data from test rooms or full scale buildings. Documentation of engineering models will use existing standard reporting formats and procedures. The impact of improved building energy analysis tools will be assessed from a building owner perspective.

The audience for the results of the Task is building energy analysis tool developers. However, tool users, such as architects, engineers, energy consultants, product manufacturers, and building owners and managers, are the ultimate beneficiaries of the research, and will be informed through targeted reports and articles.

The Task was initiated in January 1996 and is planned for completion in December 1998.

ACTIVITIES DURING 1996

- Two Working Group meetings were held during this year:

  -February 22-23 in Moret-Sur-Loing, France
  -September 25-26 in Lugano, Switzerland
- A final Research Work Plan was prepared by the Task Participants and approved by the Executive Committee.
- **Subtask A: Tool Evaluation**

  This Subtask is concerned with assessing the accuracy of available building energy analysis tools in predicting the performance of widely-used solar and low-energy concepts. Three Tool evaluation methodologies are being employed:

  1) Analytical Tests
  2) Comparative Tests
  3) Empirical Validation Tests

  Work accomplished during 1996 on each of these tool evaluation efforts is summarized below.

  Analytical Tests: A draft working document was prepared by the Finnish Task Participants based on information (analytical tests) provided by other participating Task Experts. The working document summarizes a variety of closed-form analytical solutions developed to test the accuracy of building energy analysis tools in analyzing specific heat transfer phenomena such as conduction, air flow and shading devices. The Working Document will be made available to tool developers as a set of analytical tests that can be used to ensure the proper modeling of these heat transfer processes.

  Comparative Tests: Using the test cases created in Task 12 as a starting point, a new set of comparative tests has been conceptually designed to evaluate building energy analysis tools modeling capabilities. The new tests will focus on HVAC equipment, zoning and low-energy strategies. Approximately 10 tools have been identified that will likely be used in the comparative tests.

  Empirical Validation Tests: Task Participants have agreed to a series of "blind" empirical validation exercises. The first set of exercises will use several test rooms and test houses operated by Electricity of France (EDF). The second set of exercises will focus on a commercial building test facility, yet to be selected. Preliminary analysis has been completed by France, Germany, United Kingdom, and the United States on the ETNA and GENEC test rooms. Results have not yet been distributed until all participating countries have submitted their results.

- **Subtask B: Model Documentation**

  This Subtask is concerned with the collection and documentation of existing engineering models and the creation of a models library accessible by modular tool developers. Task Participants have selected the Neutral Model Format (NMF) as the standard format for "hard" (computer-machine readable) model documentation.

  NMF is widely recognized and accepted within the international engineering and model development community. Also, several translators have been developed for converting NMF models into models usable by modular building energy analysis tools. During 1996, Task Participants reviewed the NMF reference report and handbook, and identified existing and new models to be contributed to the NMF documentation process.

PLANNED ACTIVITIES DURING 1997

Key Task research activities will be performed during 1997. In Subtask A, Tool Evaluation, the comparative evaluation test cases will be developed and implemented on up to 10 different building energy analysis tools. Final reports will be written on the blind empirical validation exercises involving the ETNA and GENEC test rooms and the Lisses test houses. A commercial building test facility will hopefully be found, instruments installed, and validation-quality data collected.

Exterior view of one of the two lisses Test Houses operated by Electricity of France in Lisses, France

In Subtask B, Model Documentation, several engineering models, such as solar collector, ground-contact domestic water preheating, and chiller, will be documented in the NMF, and installed in the Models Library server. Existing NMF translators will be used to convert NMF models into models usable by modular energy analysis simulations.

REPORTS PUBLISHED IN 1996

No official technical reports were published in 1996. However, a draft working document on Analytical Tests was prepared and distributed to the Task Participants.

REPORTS TO BE PUBLISHED IN 1997

- Subtask A: Tool Evaluation
  -Final Working Document: Analytical Tests
  -Comparative Test Case Specifications
  -Preliminary Report on Empirical Validation Exercises - ETNA and GENEC test rooms
- Subtask B: Model Documentation
  -Several Models Documented in Neutral Model Format
  -Models Library Server Operating

1996 MEETINGS

First Experts Meeting
February 22-23
Moret-Sur-Loing, France

Second Experts Meeting
September 25-26
Lugano, Switzerland

1997 MEETINGS

Third Experts Meeting
March 11-13, 1997
Location to be determined.

Fourth Experts Meeting
September 1997
Location to be determined.

TASK 22 NATIONAL CONTACT PERSONS

Operating Agent

Michael J. Holtz
Architectural Energy Corporation
2540 Frontier Avenue, Suite 201
Boulder, Colorado 80301

Finland

Ilari Aho and Pekka Tuomaala
VTT Building Technology
Energy Systems Research Group
P.O. Box 1804 (Lampomie henkuja 3, Espoo)
FIN-02044 VTT

Mika Vuolle
Helsinki University of Technology
Heating, Ventilating & Air Conditioning
Otakaari 4
Fin-02150 ESPOO

France

Souheil Soubra
CSTB
BP 209
069064 Sophia Antipolis Codex

Gilles Guyon and Sylvie Delille
Electricite de France
Les Renardieres
Route de Sens BP1
77250 Moret-sur-Loing

Elena Palomo and Gilles Lefebvre
GISE/ENPC
La Courtine Central II
93167 - Noisy le Grand

Germany

Gottfried Knabe
Technische Universität Dresden
Institut für Thermodynamik und Techn. Gebäudequsrüstung
Helmholtzstr. 14
01062 Dresden

Thomas Kretschmer
KLIMASYSTEMTECHNIK
Esdorn Jahn GmbH
Keplerstraße 8/70
10589 Berlin

Sweden

Per Sahlin and Alex Bring
Department of Building Sciences
KTH
10044 Stockholm

Petter Wallenten
Department of Building Science
University of Lund
Box 118
S-22100 Lund

Switzerland

Gerhard Zweifel and Andreas Wirz
Zentralschweizerisches
Technikum Luzern
Abt. HLK
CH-6048 Horw

Gerhard Zweifel
EMPA
Building Equipment Section
Uberlandstr. 129
Ch-8600 Dubendorf

United Kingdom

Foroutan Parand
Building Research Establishment
Bucknalls Lane
Garston
Watford Wd2 7JR

United States

Ron Judkoff and Joel Neymark
National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, Colorado 80401

Bill Beckman and Nathan Blair
Solar Energy Laboratory
1500 Engineering Drive

University of Wisconsin
Madison, Wisconsin 53706

PREVIOUS CONTENTS NEXT

Working Group: Materials In Solar Thermal Collectors

Michael Köhl
Fraunhofer Institute for Solar Energy Systems
Working Group Leader for Fraunhofer Institute for Solar Energy Systems

WORKING GROUP DESCRIPTION

The Working Group was established in the autumn of 1994 as an extension of work which had been conducted on solar collector absorbers in Subtask B of Task 10, Solar Materials R&D.

The objectives of the Working Group are:

- To develop or validate durability test procedures for solar collector materials.
- To generalize test procedures for standardization.
- To develop guidelines for solar collector design to achieve the most favorable microclimate conditions for materials.

The following areas have been identified for joint research work. In each of these areas a number of well defined projects are being conducted:

- Durability and Life-Time Assessment of Solar Absorber Coatings
- Antireflecting Devices for Solar Thermal Applications
- Methods for Characterization of Microclimate for Materials in Collectors
- Durability Aspects on the Use of Polymeric Materials in Solar Collecting Devices.

The activities of the Working Group were initiated in October 1994 and will conclude in October 1997. This year the leadership of the working group was handed from Bo Carlsson (Sweden) to Michael Köhl (Germany) as agreed upon at the start of this work.

ACTIVITIES DURING 1996

Project A: Durability and Life-time Assessment of Solar Absorber Coatings

- Project A1: To make use of the experience gained in absorber durability from existing solar installations. Absorber samples have been taken from collectors in about 15 existing solar systems and are being analyzed with respect to degradation in optical performance. The results to date confirm the outcome of the life-testing performed under IEA Task 10. The project was completed and reports published during 1996.
- Project A2: Presently, a second series of interlaboratory comparisons on durability testing of absorber coatings are being executed. Their aim is to refine the test procedures developed within the

framework of IEA Task 10 so that the reproducibility of tests can be further improved. Results from this round robin test will be a survey on the most important absorber coatings on the market and more confidence in the test procedures.

- Project A3: The experiences gained in project A2, were used to generalize recommended test procedures for an international standard proposal drafted in 1996.
- Project A4: Because the real loads on absorber coatings are not constant project A4 is focusing on the influence of cycling loads on the degradation of absorber coatings and the development of suitable indoor-test-procedures.
- Project A5: The interest in evacuated collectors is growing, therefore, a new project was initiated to modify the durability test methods according to the other degradations factors and load profiles.

Project B: Antireflecting Devices for Solar Thermal Applications

- Project B1: A research program was initiated comprising as a first step the preparation of a state-of-the-art report. This report was used as a point of departure for selecting materials for further studies. The review covers both cover plate materials such as soda lime, low iron, borosilicate glasses, and transparent polymeric materials like acrylic, fluorocarbon, polycarbonate and polyester thin sheets and foils. The next phase of this work will be on cost benefit analysis of materials selected.
- Project B2: In the second phase of work, optical and mechanical properties of selected materials will be measured in round robin tests. And in the last phase, the participants will develop accelerated tests for durability assessment of materials and compare the results with those of outdoor-tests.

Project C: Methods for Characterization of Microclimate for Materials in Collectors

- Project C1: A round robin test on test procedures for the assessment of rain tightness and air tightness of collectors was initiated in the autumn of 1995. The test procedures used are presently being discussed in the work of CEN and ISO on solar collector testing.
- Project C3: To make comparative measurements on microclimate parameters in collectors possible detailed measurements procedures for a large number of parameters, identified as important in the work of Task 10, have been formulated and reference collectors equipped with sensors and installed Working Group participants.
- Project C4: Measurements of microclimate parameters in collectors started this June in outdoor test facilities will continue for one year. The work is focused on data evaluation.
- Project C2: The results of these measurements will be utilized for refining existing mathematical models (multivariate regression, computational fluid dynamics and deterministic physical models) for calculating microclimate data for different kind of collectors in different macroclimates.

Project D: Durability Aspects on the Use of Polymeric Materials in Solar Collecting Devices

- Project D1: In order to identify new types of transparent polymeric materials, with high glass transition temperatures, for possible use as cover plate materials in collectors, a questionnaire was prepared and distributed to manufacturers of plastic materials by the participants of group. Based on the results of this inquiry a state-of-the-art report was published 1996.
- Project D2-D4: Further work on polymeric materials will be on interlaboratory comparisons of the measurements of the properties of optical and mechanical materials identified as particularly interesting. The research on artificial aging tests are to be used in the assessment of durability of materials. The comparison with outdoor test results will be carried out within the framework of project B2. In this work, reference materials tested outdoors in so called mini-collectors in Switzerland for as long as ten years will be used to design the most relevant aging test for transparent cover plate materials.

LINKS WITH INDUSTRY

All Working Group participants work closely with solar material and solar collector manufacturers, therefore, many industry representatives participate indirectly in the work being undertaken. There are also informal links to industry via the ongoing standardization work on solar collector and solar collector materials in CEN TC 312 and in ISO TC 180. Efforts also are being made to establish a liaison with CEN 312 in the area of solar collector materials.

REPORTS PUBLISHED

A list of working documents can be obtained from the Working Group Leader on request.

1996 MEETINGS

Third Experts Meeting
April 25-26
Boras, Sweden

Fourth Experts Meeting
November 13-15
Freiburg, Germany

1997 MEETINGS

Fifth Experts Meeting
June 6-7
Helsinki, Finland

To be held in conjunction with the North Sun '97 conference.

Sixth Experts Meeting
December 1-3
Golden, Colorado, USA

WORKING GROUP NATIONAL CONTACT PERSONS

Working Group Leader

Michael Köhl
Fraunhofer Institute for Solar Energy Systems ISE
Oltmannsstrasse 5v
D-79100 Freiburg
Germany

Denmark

Svend Svendsen and Ole Holck
Thermal Insulation Laboratory
Technical University of Denmark
Building 118
DK-2800 Lyngby

Finland

Seppo Peltola
Neste Ltd. Technology Centre
P.O. Box 310
FIN-06101 Porvoo

Germany

Markus Heck and Thomas Tröscher
Fraunhofer Institute for Solar Energy Systems ISE
Oltmannsstrasse 5
D-79100 Freiburg

Reiner Croy
Zentralstelle für Solartechnik
c/o Forschungszentrum Jülich, STE/ZfS
D-52425 Jülich

Netherlands

Aart de Geus
Building and Construction Research, TNO
P.O. Box 29v
NL-2600 Delft

Sweden

Bo Carlsson, Kenneth Möller, and Peter Eriksson
Materials Technology
Swedish National Testing and Research Institute
P.O. Box 857
S-50115 Boras

Arne Roos
Department of Technology
Uppsala University
Box 534
S-75121 Uppsala

Switzerland

Ueli Frei and Stefan Brunold
Solarenergie Prüf- und Forschungsstelle, Schweiz
Postfach 14 75
CH-8640 Rapperswil

United States

Gary Jorgensen
National Renewable Energy Laboratory
1617 Cole Blvd.

Golden, Colorado 80401

PREVIOUS — CONTENTS — NEXT

Address List

Please reference the current address list for the International Energy Agency - Solar Heating and Cooling programme on the following page

The IEA-SHC Address List

PREVIOUS CONTENTS NEXT

The following page lists the current IEA SHC Executive Committee Members from each of the participating countries, the Operating Agents for the currently active Tasks and Working Groups and contact information for the Executive Secretary, Advisor, and IEA Secreteriat Liaison.

The IEA SHC Address List was last updated in Febuary 2003.

» EXECUTIVE COMMITTEE MEMBERS

AUSTRALIA	
Prof. John Ballinger	
Solar Efficient Architecture P.O. Box 97 Kangaroo Valley NSW 2577	Tel: +61/2/4465 1212 Fax: +61/2/4465 1217 Email: john@jillibyfarm.com.au Site: www.unsw.becu

AUSTRIA	
Prof. Gerhard Faninger	
c/o Universität Klagenfurt, IFF Sterneckstraße 15 A-9020 Klagenfurt	Tel: +43/463/2700 6125 Fax: +43/463/2700 6199 Email: gerhard.faninger@uni-klu.ac.at

BELGIUM	
Prof. André De Herde	
Architecture et Climat Université Catholique de Louvain Place du Levant, 1 B-1348 Louvain-la-Neuve	Tel: +32/10/47 2142; +32/10/47 2223 Fax: +32/10/47 2150 Email: deherde@arch.ucl.ac.be Site: www-climat.arch.ucl.ac.be

CANADA	
Mr. Doug McClenahan	
CANMET - Natural Resources Canada 580 Booth Street Ottawa, Ontario K1A 0E4	Tel: +1/613/996 6078 Fax: +1/613/996 9416 Email: dmcclena@nrcan.gc.ca

DENMARK	
Mr. Jens Windeleff	
Danish Energy Authority Amaliegade 44 DK-1256 Copenhagen K	Tel: +45/33/92 6818 Fax: +45/33/11 4743 Email: jew@ens.dk

DENMARK alternate	
Mr. Poul E. Kristensen	
IEN Consultants Hasselvej 30 2830 Virum	Tel: +45/45/85 5092 Fax: +45/45/85 5092 Email: poulerik@adr.dk

EUROPEAN COMMISSION	
Mr. Pietro Menna	
Commission of the European Union (DG TREN) Rue de la Loi 200 B-1049 Brussels, BELGIUM	Tel: +32/2/295 1445 Fax: +32/2/299 3694 Email: pietro.menna@cec.eu.int

FINLAND	
Prof. Peter D. Lund	
Helsinki University of Technology Department of Engineering, Physics and Mathematics Rakentajanaukio 2 C P.O. Box 2200 FIN-02015 HUT (Espoo)	Tel: +358/9/451 3197; +358/9/451 3218 Fax: +358/9/451 3195 Email: peter.lund@hut.fi

FINLAND alternate	
Mr. Jerri Laine	
TEKES P.O. Box 69 FIN-00101 Helsinki	Tel: +358/105 215874 Fax +358/9/694 9196 Email: jerri.laine@tekes.fi

FRANCE	
Mr. Yves Boileau	
French Agency for the Environment and Energy Management (ADEME) 500 Route des Lucioles - Sophia Antipolis F-06565 Valbonne Cedex	Tel: +33/4/93 95 7911 Fax: +33/4/93 65 7987 Email: yves.boileau@ademe.fr

GERMANY	
Dr. Volkmar Lottner	

Forschungszentrum Jülich - BEO D-52425 Jülich	Tel: +49/2461/61 4879 Fax: +49/2461/61 3131 Email: v.lottner@FZ-Juelich.de

ITALY	
Dr. Paolo Zampetti	
Division of Systems for Energy Conservation ENEA Via Anguillarese 301 I-00060 S. Maria di Galeria (Rome)	Tel: +39/6/3048 3414 Fax: +39/6/3048 6504 Email: zampetti@casaccia.enea.it

JAPAN	
Dr. Kazuki Yoshimura	
Multifunctional Thin Film Group Institute for Structural and Engineering Materials National Institute of Advanced Industrial Science and Technology (AIST) 2266-98 Anagahora Shimoshidami Moriyama-ku Nagoya 463-8560	Tel: +81/52/736 7305 Fax: +81/52/736 7315 Email: k.yosimura@aist.go.jp

MEXICO	
Dr. Isaac Pilatowsky	
Centro de Investigacion en Energia Universidad Nacional Autonoma de Mexico Apdo. Postal #34 62580 Temixco, Morelos	Tel: +52/73/25 0052; +52/5/62 29733 Fax: +52/73/25 0018; +52/5/62 29742 Email: ipf@mazatl.cie.unam.mx Site: www.cie.unam.mx

MEXICO alternate	
Dr. Wilfrido Rivera Gomez-Franco	
Centro de Investigacion en Energia Universidad Nacional Autonoma de Mexico Apdo. Postal #34 62580 Temixco, Morelos	Tel: +52/73/25 0044 Fax: +52/73/25 0018 Email: wrgf@mazatl.cie.unam.mx Site: www.cie.unam.mx

NETHERLANDS	
Mr. Lex Bosselaar	
NOVEM P.O. Box 8242 3503 RE Utrecht (Str. address: Catharijnesingel 59)	Tel: +31/30/239 3495 Fax: +31/30/231 6491 Email: L.Bosselaar@novem.nl Site: www.novem.org

NEW ZEALAND	
Mr. Michael Donn	
School of Architecture Victoria University of Wellington P.O. Box 600 Wellington	Tel: +64/4/463 6221 Fax: +64/4/463 6204 Email: michael.donn@vuw.ac.nz Site: www.arch.vuw.ac.nz

NORWAY	
Mr. Fritjof Salvesen	
Norwegian Research Council KanEnergi AS Hoffsveien 13 0275 Oslo. NORWAY	Tel: +47/2206 5773 Fax: +47/2206 5769 Email: fritjof.salvesen@kanenergi.no Mobile: +47/4040 7853

PORTUGAL	
Mr. Joao A. Farinha Mendes	
INETI - Edificio G Departamento de Energias Renovaveis Estrada do Paco do Lumiar, 22 1649-038 Lisboa	Tel: +351/21/712 7186 Fax: +351/21/712 7195 Email: farinha.mendes@ineti.pt

SPAIN Vice Chairman	
Mrs Maria Luisa Delgado-Medina	
Head of Renewable Energy Dept. CIEMAT Avda/Complutense, No. 22 Edificio 42 28040 Madrid	Tel: +34/91/346 6050 Fax: +34/91/346 6037 Email: luisa.delgado@ciemat.es

SWEDEN Chairman	
Mr. Michael Rantil	
Formas - The Swedish Research Council For Environment, Agricultural Sciences and Spatial Planning Box 1206, SE-111 82 Stockholm Visiting address: Birger Jarls torg 5	Tel: +46/8/755 4067 Fax: Email: Michael.rantil@formas.se Site: www.formas.se

SWITZERLAND	
Mr. Urs Wolfer	

Federal Office of Energy CH-3003 Bern Visiting address: Worblentalstr. 32, 3063 Ittigen	Tel: +41/31/322 5639 Fax: +41/31/323 2500 Email: urs.wolfer@bfe.admin.ch

UNITED KINGDOM	
Dr. Earle Perera	
BRE Bucknalls Lane Garston, Watford Herts WD2 7JR	Tel: +44/1923/664 486 Fax: +44/1923/664 095 Email: pererae@bre.co.uk Site: www.bre.co.uk

UNITED STATES Vice Chairman	
Mr. Drury Crawley	
U.S. Department of Energy Energy Efficiency and Renewable Energy EE-2J, Room 1M-048 1000 Independence Ave. S.W. Room IM048 Washington, D.C. 20585-0121	Tel: +1/202/586 2344 Fax: +1/202/586 4617 Email: drury.crawley@ee.doe.gov Site: www.eren.doe.gov/buildings/

» OPERATING AGENTS

TASK 22	
Mr. Michael J. Holtz	
Architectural Energy Corporation 2540 Frontier Avenue, Suite 201 Boulder, CO 80301 USA	Tel: +1/303/444 4149 Fax: +1/303/444 4304 Email: mholtz@archenergy.com Site: www.archenergy.com

TASK 23	
Prof. Anne Grete Hestnes	
Faculty of Architecture Norwegian University of Science and Technology N-7491 Trondheim. NORWAY	Tel: +47/73/59 5037 Fax: +47/73/59 5045 Email: annegrete.hestnes@ark.ntnu.no

TASK 24	
Dr. Hans Westling	

Promandat AB Box 27103 S-104 51 Stockholm. SWEDEN	Tel: +46/8/667 8020 Fax: +46/8/660 5482 Email: hans.westling@promandat.se

TASK 25	
Dr. Hans-Martin Henning	
Fraunhofer-Institut für Solare Energiesysteme ISE Abteilung Thermische und Optische Systeme Heidenhofstr 2 D-79100 Freiburg. GERMANY	Tel: +49/761/4588 5134 Fax: +49/761/4588 9000 Email: hans-martin.henning@ise.fhg.de

TASK 26	
Mr. Werner Weiss	
AEE INTEC Feldgasse 19 A-8200 Gleisdorf. AUSTRIA	Tel: +43/3112 5886 17 Fax: +43/3112 5886 18 Email: w.weiss@aee.at

TASK 27	
Mr. Michael Köhl	
Fraunhofer Institute for Solar Energy Sytems Heidenhofstr. 2 D-79 100 Freiburg, GERMANY	Tel: +49/761 4016682 Fax: +49/761 4016681 Email: mike@ise.fhg.de

TASK 28	
Mr Robert Hastings	
Architecture, Energy & Environmnetal GmbH Kirchstrasse 1 CH-8304 Wallisellen. SWITZERLAND	Tel: +41/1/833 1717 or 16 Fax: +41/1/883-1713 Email: robert.hastings@aue.ch

TASK 29	
Mr Doug Lorriman	
Namirrol Ltd. 38 Morden Neilson Way Georgetown, ON CANADA L7G 5Y8	Tel: +1/905/873 3149 Fax: +1/905/873 2735 Email: dpl@aztec-net.com

TASK 31	

Dr. Nan Ruck	
79 Amaroo Drive Smiths Lake, NSW 2428 AUSTRALIA	Tel: +61/2/65/544 073 Fax: +61/2/65/544 073 Email: ncr1@austarnet.com.au

TASK 32	
Mr. Jean-Christophe Hadorn	
Swiss Federal Office of Energy CH-1035 Bournens SWITZERLAND	Tel: +41/79/210 5706 Fax: +41/21/732 1320 Email: jean-christophe.adorn@bluewin.ch

TASK 33 Task Organizer	
Mr. Werner Weiss	
AEE INTEC Feldgasse 19 A-8200 Gleisdorf. AUSTRIA	Tel: +43/3112 5886 17 Fax: +43/3112 5886 18 Email: w.weiss@aee.at

» WORKING GROUP

PV-THERMAL SOLAR SYSTEMS	
Henrik Sørensen	
Head of Branch Office and Energy and Indoor Climate Section Esbensen Consulting Engineers Ltd. Vesterbrogade 124 B DK-1620 Copenhagen V. DENMARK	Tel: +45/33/26 7304 Fax: +45/33/26 7301 Email: h.soerensen@esbensen.dk Site: www.esbensen.dk

» ADMINISTRATIVE MEMBERS

EXECUTIVE SECRETARY	
Ms. Pamela Murphy	
Morse Associates, Inc. 1808 Corcoran Street, NW Washington, DC 20009. USA	Tel: +1/202/483 2393 Fax: +1/202/265 2248 Email: pmurphy@MorseAssociatesInc.com

ADVISOR	
Dr. Frederick H. Morse	
Morse Associates, Inc 1808 Corcoran Street, N.W Washington, DC 20009, USA	Tel: +1/202/483 23 93 Fax: +1/202/265 22 48 Email: fredmorse@MorseAssociatesInc.com

IEA SECRETARIAT LIAISON	
Mr. Johan Wide	
International Energy Agency 9 rue de la Fédération 75739 Paris Cedex 15 FRANCE	Tel: +33/1/4057 6721 Fax: +33/1/4057 6749 Email: johan.Wide@iea.org

JUMP TO ADDRESS + Quick link to IEA addresses FIND

The following page lists the current IEA SHC Executive Committee Members from each of the participating countries, the Operating Agents for the currently active Tasks and Working Groups and contact information for the Executive Secretary, Advisor, and IEA Secreteriat Liaison.

The IEA SHC Address List was last updated in Febuary 2003.

» EXECUTIVE COMMITTEE MEMBERS

AUSTRALIA	
Prof. John Ballinger	
Solar Efficient Architecture P.O. Box 97 Kangaroo Valley NSW 2577	Tel: +61/2/4465 1212 Fax: +61/2/4465 1217 Email: john@jillibyfarm.com.au Site: www.unsw.becu

AUSTRIA	
Prof. Gerhard Faninger	
c/o Universität Klagenfurt, IFF Sterneckstraße 15 A-9020 Klagenfurt	Tel: +43/463/2700 6125 Fax: +43/463/2700 6199 Email: gerhard.faninger@uni-klu.ac.at

BELGIUM	
Prof. André De Herde	
Architecture et Climat Université Catholique de Louvain Place du Levant, 1 B-1348 Louvain-la-Neuve	Tel: +32/10/47 2142; +32/10/47 2223 Fax: +32/10/47 2150 Email: deherde@arch.ucl.ac.be Site: www-climat.arch.ucl.ac.be

CANADA	
Mr. Doug McClenahan	
CANMET - Natural Resources Canada 580 Booth Street Ottawa, Ontario K1A 0E4	Tel: +1/613/996 6078 Fax: +1/613/996 9416 Email: dmcclena@nrcan.gc.ca

DENMARK	
Mr. Jens Windeleff	
Danish Energy Authority Amaliegade 44 DK-1256 Copenhagen K	Tel: +45/33/92 6818 Fax: +45/33/11 4743 Email: jew@ens.dk

DENMARK alternate	
Mr. Poul E. Kristensen	
IEN Consultants Hasselvej 30 2830 Virum	Tel: +45/45/85 5092 Fax: +45/45/85 5092 Email: poulerik@adr.dk

EUROPEAN COMMISSION	
Mr. Pietro Menna	
Commission of the European Union (DG TREN) Rue de la Loi 200 B-1049 Brussels, BELGIUM	Tel: +32/2/295 1445 Fax: +32/2/299 3694 Email: pietro.menna@cec.eu.int

FINLAND	
Prof. Peter D. Lund	
Helsinki University of Technology Department of Engineering, Physics and Mathematics Rakentajanaukio 2 C P.O. Box 2200 FIN-02015 HUT (Espoo)	Tel: +358/9/451 3197; +358/9/451 3218 Fax: +358/9/451 3195 Email: peter.lund@hut.fi

FINLAND alternate	
Mr. Jerri Laine	
TEKES P.O. Box 69 FIN-00101 Helsinki	Tel: +358/105 215874 Fax +358/9/694 9196 Email: jerri.laine@tekes.fi

FRANCE	
Mr. Yves Boileau	
French Agency for the Environment and Energy Management (ADEME) 500 Route des Lucioles - Sophia Antipolis F-06565 Valbonne Cedex	Tel: +33/4/93 95 7911 Fax: +33/4/93 65 7987 Email: yves.boileau@ademe.fr

GERMANY	
Dr. Volkmar Lottner	
Forschungszentrum Jülich - BEO D-52425 Jülich	Tel: +49/2461/61 4879 Fax: +49/2461/61 3131 Email: v.lottner@FZ-Juelich.de

ITALY	
Dr. Paolo Zampetti	
Division of Systems for Energy Conservation ENEA Via Anguillarese 301 I-00060 S. Maria di Galeria (Rome)	Tel: +39/6/3048 3414 Fax: +39/6/3048 6504 Email: zampetti@casaccia.enea.it

JAPAN	
Dr. Kazuki Yoshimura	
Multifunctional Thin Film Group Institute for Structural and Engineering Materials National Institute of Advanced Industrial Science and Technology (AIST) 2266-98 Anagahora Shimoshidami Moriyama-ku Nagoya 463-8560	Tel: +81/52/736 7305 Fax: +81/52/736 7315 Email: k.yosimura@aist.go.jp

MEXICO	
Dr. Isaac Pilatowsky	
Centro de Investigacion en Energia Universidad Nacional Autonoma de Mexico Apdo. Postal #34 62580 Temixco, Morelos	Tel: +52/73/25 0052; +52/5/62 29733 Fax: +52/73/25 0018; +52/5/62 29742 Email: ipf@mazatl.cie.unam.mx Site: www.cie.unam.mx

MEXICO alternate	
Dr. Wilfrido Rivera Gomez-Franco	
Centro de Investigacion en Energia Universidad Nacional Autonoma de Mexico Apdo. Postal #34 62580 Temixco, Morelos	Tel: +52/73/25 0044 Fax: +52/73/25 0018 Email: wrgf@mazatl.cie.unam.mx Site: www.cie.unam.mx

NETHERLANDS	
Mr. Lex Bosselaar	

NOVEM P.O. Box 8242 3503 RE Utrecht (Str. address: Catharijnesingel 59)	Tel: +31/30/239 3495 Fax: +31/30/231 6491 Email: L.Bosselaar@novem.nl Site: www.novem.org

NEW ZEALAND	
Mr. Michael Donn	
School of Architecture Victoria University of Wellington P.O. Box 600 Wellington	Tel: +64/4/463 6221 Fax: +64/4/463 6204 Email: michael.donn@vuw.ac.nz Site: www.arch.vuw.ac.nz

NORWAY	
Mr. Fritjof Salvesen	
Norwegian Research Council KanEnergi AS Hoffsveien 13 0275 Oslo. NORWAY	Tel: +47/2206 5773 Fax: +47/2206 5769 Email: fritjof.salvesen@kanenergi.no Mobile: +47/4040 7853

PORTUGAL	
Mr. Joao A. Farinha Mendes	
INETI - Edificio G Departamento de Energias Renovaveis Estrada do Paco do Lumiar, 22 1649-038 Lisboa	Tel: +351/21/712 7186 Fax: +351/21/712 7195 Email: farinha.mendes@ineti.pt

SPAIN Vice Chairman	
Mrs Maria Luisa Delgado-Medina	
Head of Renewable Energy Dept. CIEMAT Avda/Complutense, No. 22 Edificio 42 28040 Madrid	Tel: +34/91/346 6050 Fax: +34/91/346 6037 Email: luisa.delgado@ciemat.es

SWEDEN Chairman	
Mr. Michael Rantil	

Formas - The Swedish Research Council For Environment, Agricultural Sciences and Spatial Planning Box 1206, SE-111 82 Stockholm Visiting address: Birger Jarls torg 5	Tel: +46/8/755 4067 Fax: Email: Michael.rantil@formas.se Site: www.formas.se

SWITZERLAND	
Mr. Urs Wolfer	
Federal Office of Energy CH-3003 Bern Visiting address: Worblentalstr. 32, 3063 Ittigen	Tel: +41/31/322 5639 Fax: +41/31/323 2500 Email: urs.wolfer@bfe.admin.ch

UNITED KINGDOM	
Dr. Earle Perera	
BRE Bucknalls Lane Garston, Watford Herts WD2 7JR	Tel: +44/1923/664 486 Fax: +44/1923/664 095 Email: pererae@bre.co.uk Site: www.bre.co.uk

UNITED STATES Vice Chairman	
Mr. Drury Crawley	
U.S. Department of Energy Energy Efficiency and Renewable Energy EE-2J, Room 1M-048 1000 Independence Ave. S.W. Room IM048 Washington, D.C. 20585-0121	Tel: +1/202/586 2344 Fax: +1/202/586 4617 Email: drury.crawley@ee.doe.gov Site: www.eren.doe.gov/buildings/

» OPERATING AGENTS

TASK 22	
Mr. Michael J. Holtz	
Architectural Energy Corporation 2540 Frontier Avenue, Suite 201 Boulder, CO 80301 USA	Tel: +1/303/444 4149 Fax: +1/303/444 4304 Email: mholtz@archenergy.com Site: www.archenergy.com

TASK 23	
Prof. Anne Grete Hestnes	
Faculty of Architecture Norwegian University of Science and Technology N-7491 Trondheim. NORWAY	Tel: +47/73/59 5037 Fax: +47/73/59 5045 Email: annegrete.hestnes@ark.ntnu.no

TASK 24	
Dr. Hans Westling	
Promandat AB Box 27103 S-104 51 Stockholm. SWEDEN	Tel: +46/8/667 8020 Fax: +46/8/660 5482 Email: hans.westling@promandat.se

TASK 25	
Dr. Hans-Martin Henning	
Fraunhofer-Institut für Solare Energiesysteme ISE Abteilung Thermische und Optische Systeme Heidenhofstr 2 D-79100 Freiburg. GERMANY	Tel: +49/761/4588 5134 Fax: +49/761/4588 9000 Email: hans-martin.henning@ise.fhg.de

TASK 26	
Mr. Werner Weiss	
AEE INTEC Feldgasse 19 A-8200 Gleisdorf. AUSTRIA	Tel: +43/3112 5886 17 Fax: +43/3112 5886 18 Email: w.weiss@aee.at

TASK 27	
Mr. Michael Köhl	
Fraunhofer Institute for Solar Energy Sytems Heidenhofstr. 2 D-79 100 Freiburg, GERMANY	Tel: +49/761 4016682 Fax: +49/761 4016681 Email: mike@ise.fhg.de

TASK 28	
Mr Robert Hastings	
Architecture, Energy & Environmnetal GmbH Kirchstrasse 1 CH-8304 Wallisellen. SWITZERLAND	Tel: +41/1/833 1717 or 16 Fax: +41/1/883-1713 Email: robert.hastings@aue.ch

TASK 29	
Mr Doug Lorriman	
Namirrol Ltd. 38 Morden Neilson Way Georgetown, ON CANADA L7G 5Y8	Tel: +1/905/873 3149 Fax: +1/905/873 2735 Email: dpl@aztec-net.com

TASK 31	
Dr. Nan Ruck	
79 Amaroo Drive Smiths Lake, NSW 2428 AUSTRALIA	Tel: +61/2/65/544 073 Fax: +61/2/65/544 073 Email: ncr1@austarnet.com.au

TASK 32	
Mr. Jean-Christophe Hadorn	
Swiss Federal Office of Energy CH-1035 Bournens SWITZERLAND	Tel: +41/79/210 5706 Fax: +41/21/732 1320 Email: jean-christophe.adorn@bluewin.ch

TASK 33 Task Organizer	
Mr. Werner Weiss	
AEE INTEC Feldgasse 19 A-8200 Gleisdorf. AUSTRIA	Tel: +43/3112 5886 17 Fax: +43/3112 5886 18 Email: w.weiss@aee.at

» WORKING GROUP

PV-THERMAL SOLAR SYSTEMS	
Henrik Sørensen	
Head of Branch Office and Energy and Indoor Climate Section Esbensen Consulting Engineers Ltd. Vesterbrogade 124 B DK-1620 Copenhagen V. DENMARK	Tel: +45/33/26 7304 Fax: +45/33/26 7301 Email: h.soerensen@esbensen.dk Site: www.esbensen.dk

» ADMINISTRATIVE MEMBERS

EXECUTIVE SECRETARY	
Ms. Pamela Murphy	
Morse Associates, Inc. 1808 Corcoran Street, NW Washington, DC 20009. USA	Tel: +1/202/483 2393 Fax: +1/202/265 2248 Email: pmurphy@MorseAssociatesInc.com

ADVISOR	
Dr. Frederick H. Morse	
Morse Associates, Inc 1808 Corcoran Street, N.W Washington, DC 20009, USA	Tel: +1/202/483 23 93 Fax: +1/202/265 22 48 Email: fredmorse@MorseAssociatesInc.com

IEA SECRETARIAT LIAISON	
Mr. Johan Wide	
International Energy Agency 9 rue de la Fédération 75739 Paris Cedex 15 FRANCE	Tel: +33/1/4057 6721 Fax: +33/1/4057 6749 Email: johan.Wide@iea.org