2002 Annual Report IEA Solar Heating & Cooling Programme

With a Feature on

Integrated Design Process

IEA Solar Heating & Cooling Programme

2002 Annual Report

Edited by
Pamela Murphy
Executive Secretary
IEA Solar Heating and Cooling Programme

Morse Associates, Inc.
1808 Corcoran Street, N.W.
Washington, DC 20009
USA

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The Solar Heating & Cooling Implementing Agreement

BACKGROUND

The International Energy Agency was established as an intergovernmental organization in November, 1974 under the Agreement on an International Energy Program (IEP) after the oil shock of 1973/1974.The 25 Member countries of the IEA have committed themselves to take effective measures to meet any oil supply emergency and, over the long term, to reduce dependence on oil. Means to attain their objective include increased energy efficiency, conservation, and the development of coal, natural gas, nuclear power and renewable energy sources.

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 42 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.

SHC Member Countries

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

CURRENT TASKS

A total of thirty-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 2002 and their respective Operating Agents are:

Task 22
Building Energy Analysis Tools
United States

Task 23
Optimization of Solar Energy Use in Large Buildings
Norway

Task 24
Solar Procurement
Sweden

Task 25
Solar Assisted Air Conditioning of Buildings
Germany

Task 26
Solar Combisystems
Austria

Task 27
Performance of Solar Facade Components
Germany

Task 28
Sustainable Solar Housing
Switzerland

Task 29
Solar Crop Drying
Canada

Task 31
Daylighting Buildings in the 21st Century
Australia

Chairman's Report: Highlights of 2002

Mr. Michael Rantil
Executive Committee Chairman
Formas, Sweden

OVERVIEW

In 2002, the Solar Heating and Cooling Programme celebrated 25 years of accelerating the solar market and contributing to the R&D of solar technologies. The activities undertaken by the Executive Committee of the SHC Programme ranged from producing reports on the solar thermal collector market in IEA countries and on solar energy activities in IEA countries to starting new work in the areas of storage, industrial process heat, and building energy analysis tools.

As the new Chairman of the Programme, I am looking forward to a continuation of the creative cooperation on high quality R&D and important market activities as well as an increased role in fostering solar technology.

This year, the Programme continued to focus its work on expanding the solar market and addressing design and technology issues facing solar energy. The Executive Committee continued to collect data on the use of solar collectors in the Member countries. The report, *Solar Thermal Collector Market in IEA Member Countries*, is a result of this work. The analysis of this data shows a strong solar market and a significant impact that solar energy is having on greenhouse gas emission reductions. The calculated annual collector yield of all the recorded systems, excluding air collectors, in 22 IEA Member countries is approximately 21,300 GWh (76,900 TJ). This is an oil equivalent of 3.4 billion liters and an annual avoidance of 9.3 million tons of CO_2.

To continue the Programme's support of the advancement of solar design and technologies, the Executive Committee finalized arrangements for presenting the first SHC Solar Award. An award design was selected from a pool of artists and the first award will be presented at the ISES World Congress in Sweden in June 2003.

The Executive Committee approved two new Tasks and the Concept Definition Phase of another Task. The two new Tasks—Task 32 is on Storage Concepts for Solar Buildings and Task 33 is on Solar Heat for Industrial Processes—will begin in 2003. The other new work is a follow-up Task to the current Task 22 on Building Energy Analysis Tools. The Executive Committee also approved the completion of Task 23, Optimization of Solar Energy Use in Large Buildings. It is with sadness that the Committee says farewell to Prof. Anne Grete Hestnes, the Operating Agent of this Task as well as for the earlier Task 13 on Advanced Solar Low Energy Buildings, and an expert for Task 11 on Passive and Hybrid Solar Commercial Buildings.

The Tasks continue to disseminate results through publications, conference presentations and workshops. Workshops that were organized in 2002 include: Task 23 seminars and workshops, Task 25 presentation at the Light & Bulb Trade Fair in Germany, and Task 26 Industry Workshops.

In addition to the Task work, the Committee continues its support of the Working Group on PV/Thermal systems (a joint activity with the IEA Photovoltaic Power Systems Implementing Agreement).

Participation in the Programme remains strong with 20 Member countries and the European Union actively participating in its work. This year, an observer from China attended the November Executive Committee. In addition to China, the Executive Committee has been in communication with the following countries that have been invited to join the Programme: Brazil, Cyprus, Egypt, Greece, Republic of South Korea, and Turkey.

In 2003, the Executive Committee will begin to prepare a new Strategic Plan. This process will provide the Committee the opportunity to continue to assess the Programme's work and its impact on the national solar programs of the Member countries. It is my belief that this assessment will show that collaborative work is cost efficient and that we will find sound strategies that are appropriate for the new challenges we are facing.

Michael Rantil

Highlights of 2002

TASKS AND WORKING GROUP

Notable achievements of the Programme's work during 2003 are presented below. The details of these and many other accomplishments are covered in the individual Task summaries later in this report.

Task 22: Building Energy Analysis Tools

A significant achievement during 2002 is the publication of *ASHRAE Standard 140-2001*, which incorporates the IEA BESTEST suite of test cases. *ASHRAE Standard 140* has been given the status of continuous maintenance which means as new test cases become available from Task 22 and other sources they can be reviewed and integrated into a revised version of ASHRAE Standard 140.

Task 23: Optimization of Solar Energy Use in Large Buildings

This Task concluded in 2002. The work of the Task has enabled building designers to carry out trade-off analyses between the need for and potential use of energy conservation, daylighting, passive solar, active solar, and photovoltaic technologies in systematic design processes. To ensure that the buildings promote sustainable development, Task work included considerations of other resource use and of local and global environmental impact in the trade-off analyses to be carried out. Five buildings were constructed in Denmark, Canada, Germany, and the Netherlands. These buildings have served two purposes–provided an opportunity to test the guidelines and tools developed, and provided an effective way to demonstrate integration of technologies in real buildings and to promote "sustainable solar buildings."

Task 24: Solar Procurement

Belgium joined the Task in 2002. Solar procurement activities in Belgium included a tender for the "Brussels Solar Water Heater Promotion Campaign" for two medium-sized installations (100 m^2 each) and preparations for another VLAZON project with the Belgian Solar Industry Association and the Flemish Regional Government. In Sweden a competition on domestic solar heaters was finalized and the winning low-cost system is already on the market.

Task 25: Solar Assisted Air Conditioning of Buildings

A solar assisted desiccant cooling demonstration model was produced for trade fairs and other events. This model and Task results were shown at a joint exhibition with Fachinstitut Gebäude-Klima, a German association of air conditioning companies, at the Light & Building Trade Fair in Frankfurt, Germany.

Task 26: Solar Combisystems
Test facilities have been established at ITW in Germany, SP in Sweden and SPF in Switzerland. Earlier in 2002, ITW and SP tested two solar combisystems according to CTSS and earlier drafts of the DC test method, and SFP tested systems according to the CCT test method. In 2003, tests will be conducted at CSTB in France and TNO in the Netherlands. Work with CEN TC 312 continues and Subtask B participants will prepare a presentation for the next CEN meeting in mid-2003.

Task 27: Performance of Solar Facade Components
Manufacturers and potential consumers have benefited from the Task's testing of switchable glazing to ensure their performance and reliability before they enter the market.

Task 28/ECBCS Annex 38: Sustainable Solar Housing
This Task has a working group on hot climates which is examining designs for sustainable housing in cooling dominated climates. Design principles are being drawn from the experience from built projects, including passive cooled houses in Australia, pilot low income houses in Brazil, an urban housing typology in Rome, indigenous house forms in Indonesia, and innovative technical solutions in Japan.

Task 29: Solar Crop Drying
Projects in the United States have been added to this Task. There are two systems in California—prune drying and walnut drying. And two projects in New York State—wool drying and chicken manure drying. A third system in New York State is expected to be operating soon to dry grain.

Task 31: Daylighting Buildings in the 21st Century
A joint meeting with the CIE Division 3: Interior Environment and Lighting Design was held in October 2002. And, the Task was presented at the Fraunhofer Daylight Exhibition Stand at the Light and Building Fair in Germany in April 2002. There were 12,000 visitors to the exhibition stand, and there are plans to have a similar exhibition at a trade fair in Singapore in November 2003. At the fair there were presentations on ADELINE, DIAL and other daylighting tools, a user needs survey, and seminars and workshops.

Working Group on PV/Thermal Systems
The objectives of this Working Group are to exchange information, to prepare a "road map" by identifying the necessary international steps needed to develop various markets for PV/Thermal systems, and to advise the IEA on further work in this field. The Working Group is a collaborative effort with the IEA Photovoltaic Power Systems Programme.

NEW ACTIVITIES

Task 32: Storage Concepts for Solar Buildings
The objectives of this new work are to contribute to the development of advanced storage solutions in thermal solar systems for buildings and to propose advanced storage solutions for other heating or cooling technologies than solar. The goal of the Task is not to develop new storage systems independent of a system application, but to focus on the integration of advanced storage concepts in a thermal system for low energy housing. The work will be organized into four subtasks: Subtask A: State of the Art, Common Specifications, Evaluation and Knowledge Dissemination, Subtask B: Storage Concepts Based on Chemical Reactions and on the Sorption Principle, Subtask C: Storage Concepts Based on Phase Change Materials, Subtask D: Storage Concepts Based on Advanced Water Tanks and Special Devices.

The proposed start date is 1 July 2003.

Task 33: Solar Heat for Industrial Processes
The objective for this new work is to focus on the integration of solar thermal systems into industrial processes with temperatures up to 250°C. The goals of the Task include collecting and sharing knowledge and experiences; providing methods and tools to analyze a wide range of solar applications for the industry; helping to coordinate research and development of solar thermal systems for industrial applications leading to improvements in both performance and costs; ensuring the reliability of new materials and components; and demonstrating that sys-

tems providing solar heat for industrial applications are reliable and economical, as well as environmentally useful. It is proposed that the work be organized into four subtasks Subtask A: Solar Process Heat Survey and Dissemination of Task Results, Subtask B: Investigation of Industrial Processes, Subtask C: System Integration and Demonstration, and Subtask D: Collectors and Components.

At the request of the SolarPaces Implementing Agreement, the Executive Committee has agreed that this activity should be a joint Task. The proposed start date is September 2003.

Follow-up Task on Building Energy Analysis

This proposed Task builds upon the work of SHC Tasks 8, 12 and 22. The goal of this new work is to conduct pre-normative research to develop a comprehensive and integrated suite of building energy analysis tool tests involving analytical, comparative and empirical methods for purposes of quality assurance during tool development and certification of tools for energy standard or code compliance. The work would involve research to develop and test a number of building energy analysis tool evaluation tests.

A Task Definition meeting will be held in March/April 2003.

Market Analysis of Solar Heating and Cooling Markets

A series of Market Forums are being considered. These informal forums will provide participants with the opportunity to discuss and debate the important aspects of expanding the market for solar technologies and designs in the building sector and to identify and better understand promising ways to facilitate greater market successes.

The first forum is being planned for June 2003.

MANAGEMENT ACTIONS

SHC Award

The Programme will present an award at the ISES World Congress in Sweden in June 2003 to a person, organization or company that has presented outstanding leadership or achievements, with links to the IEA Solar Heating and Cooling Programme, in the field of solar energy at the international level within one or more of the following sectors– technical developments, successful market activities, or information.

Programme and Policy Actions

- The Committee elected Mr. Michael Rantil of Sweden as the new Executive Committee Chairman.
- The Committee elected Ms. Maria Luisa Delgado-Medina of Spain and Mr. Drury Crawley of the United States as the new Executive Committee Vice-Chairs. Mr. Doug McClenahan of Canada stepped down after serving in this position for several years along with Mr. Michael Rantil.
- The Committee prepared the SHC End-of-Term report for the IEA and will submit it in 2003 along with a request for a 5-year extension of the Implementing Agreement.
- The Committee approved the final management report of Task 23: Optimization of Solar Energy Use in Large Buildings.
- The Committee produced a new Programme slide show to celebrate its 25th anniversary.
- The Committee sent the SHC exhibit to AirCon Tec 2002 Trade Fair in Germany as part of a Task 25 session and to the Sustainable Buildings 2002 conference in Norway.
- In 2003, the Programme will host a joint reception with the IEA PVPS Programme at the ISES World Congress in June 2003.
- Communication continued with the following countries that have already been invited to join the Implementing Agreement – Brazil, China, Cyprus, Egypt, Greece, Republic of South Korea, and Turkey.

Executive Committee Meetings

2002 Meetings

The 51st Executive Committee meeting was held in June 2002 in Lisbon, Portugal. During this meeting, a half-day workshop on the current Tasks was held for the Portuguese and a one-day session on national solar energy activities followed by a discussion on SHC management issues.

The 52nd Executive Committee meeting was held in November 2002 in Brussels, Belgium. Following the Executive Committee meeting, a joint meeting with the IEA Energy Storage Implementing Agreement was held and a final technical presentation on Task 23: Optimization of Solar Energy Use in Large Buildings was given.

2003 Meetings
The 2003 Executive Committee meetings will be held 11-13 June in Potsdam, Germany and 19-21 November in Wellington, New Zealand.

Internet Site
The Solar Heating and Cooling Programme's website continues to be updated and new pages added as needed. The site plays an increasingly important role in the dissemination of Programme and Task information. At this time, final documentation and reports have been added for Task 21: Daylight in Buildings and Task 23: Optimization of Solar Energy Use in Large Buildings. The Executive Committee continues to encourage the posting of as many Programme and Task reports as possible to the web site. In 2003, the Webmaster will work to add PDF files of the popular reports from completed Tasks to the web site. The address for the site is www.iea-shc.org.

Future Workshops
The Programme will organize the following workshops in 2003.

Task Definition Workshop for the Follow-up Task on Building Energy Analysis in March/April 2003.
The workshop will be draw experts together to prepare a new Task on pre-normative research to develop a comprehensive and integrated suite of building energy analysis tool tests involving analytical, comparative and empirical methods for purposes of quality assurance during tool development and certification of tools for energy standard or code compliance.

Market Forum on Solar Market Initiatives in June 2003.
Participants will discuss and debate the important aspects of expanding the market for solar technologies and designs in the building sector and to identify and better understand promising ways to facilitate greater market successes.

Task 30: Solar City
After many discussions, the ExCo agreed to stop work on Task 30 due to a lack of funding by the lead country, Australia, and a lack of funding by other countries to participate in the proposed work. Recognizing the importance of this topic, the Executive Committee has agreed to reconsider a Task on solar cities should Member countries express interest and have funding. Several Executive Committee members supported the idea of a new IEA Implementing Agreement to handle this topic.

COORDINATION WITH OTHER IEA IMPLEMENTING AGREEMENTS AND NON-IEA ORGANIZATIONS
The IEA Energy Conservation in Buildings and Community Systems Programme is collaborating in two SHC Programme Tasks—Performance of Solar Facade Components and Sustainable Solar Housing. A joint meeting was held in June 2001 in France. The next joint Executive Committee meeting is planned for June 2003 in Germany to facilitate the continued collaborative work between the Programmes.

The IEA Buildings Related Implementing Agreements (BRIA) is composed of the seven building-related IEA Implementing Agreements. The SHC Chairman attended the meeting held in June 2002 and supports the group's aim to share results and to improve the dissemination and visibility of the Implementing Agreements work.

The IEA Photovoltaic Power Systems Programme is working with the SHC Programme in the PV/Thermal Systems Working Group. The SHC Programme also is reviewing the proposed PVPS Task 10: Urban Scale PV. In addition, the SHC Programme will host a joint reception with the PVPS Programme at the ISES 2003 World Congress in Sweden.

The IEA Energy Storage Programme held a joint meeting with the SHC Programme in November 2002. The meeting was the first of its kind and provided an opportunity for each Programme to share information on relevant current Tasks as well as the SHC new Task on Advanced Storage Concepts for Solar Thermal Systems in Low Energy Buildings.

PUBLICATIONS
The following Solar Heating and Cooling report was prepared in 2002, but it is not listed elsewhere in this annual report.

Solar Thermal Collector Market in IEA Member Countries
This report documents the installed collector area to ascertain the contribution of solar plants to the supply of energy and avoidance of CO_2 emissions.

FEATURE ARTICLE
Every year the SHC Annual Report includes a feature article on some

aspect of solar technologies for buildings. This year's article is about SHC Task 23's work on an integrated design process for solar low energy buildings. Thanks to Prof. Anne Grete Hestnes of the Norwegian University of Science and Technology for contributing this overview.

ACKNOWLEDGMENTS

In closing, I would like to thank the Operating Agents, Working Group Leader, participating experts, Executive Committee Members and our Advisor, Fred Morse, for their work. I would especially like to thank our Executive Secretary, Pamela Murphy, for her help over the past year in preparation and reporting of the meetings and numerous Programme activities as well as helping to run this active IEA Programme.

Solar Low Energy Buildings and the Integrated Design Process

Anne Grete Hestnes
Faculty of Architecture and Fine Art
Norwegian University of Science and Technology
Norway

Based on the IEA SHC Task 23 booklet *"Solar Low Energy Buildings and the Integrated Design Process"* by Nils Larsson et. al.

The Need for Better Performance

The global drive towards sustainable development has resulted in an increasing level of pressure on building developers and designers to produce buildings with a markedly higher level of environmental performance. Although various experts have somewhat different interpretations, a consensus view is that such buildings must achieve measurably high performance, over the full lifecycle, in the following areas:

- Minimal use of non-renewable resources, including land, water, materials and fossil fuels;
- Minimal atmospheric emissions related to global warming and acidification;
- Minimal liquid effluents and solid wastes;
- Minimal negative impacts on site ecosystems;
- Maximum quality of indoor environment, in the areas of air quality, thermal regime, illumination, and acoustics/noise.

Some authorities in this rapidly developing field would add related issues such as adaptability, flexibility, and operating cost as well as lifecycle cost. In addition to a new breadth of performance issues to be addressed, contemporary developers and designers are faced with more stringent performance requirements being imposed by markets or regulation, or both. Chief amongst these is energy performance, and this poses a definite challenge to designers, in terms of reducing purchased energy use and in the application of solar technologies, all within the constraints of minimal fees and the time pressure of the modern development process.

The Conventional Design Process

Although there are many exceptions, we can refer to a "traditional" design process as consisting of the following features:

- The architect and the client agree on a design concept, consisting of a general massing scheme, orientation, fenestration and, usually, the general exterior appearance as determined by these characteristics as well as basic materials;
- The mechanical and electrical engineers are then asked to implement the design and to suggest appropriate systems.

Although this is vastly oversimplified, such a process is one that is followed by the large majority of general-purpose design firms, and it generally limits the performance levels achievable to conventional levels. The traditional design process has a mainly linear structure due to the successive contributions of the members of the design team. There is a limited possibility of optimization during the traditional process, while optimization in the later stages of the process is often troublesome or even impossible. The design and performance implications of such a process often include the following practical consequences:

- The building takes little advantage of the potential benefits offered by solar gain during the heating season, resulting in greater heating demand;
- The building may be exposed to

high cooling loads during the summer, due to excessive glazing exposed to summer sun;

- The building may not be designed to take advantage of its daylighting potential, due to a lack of appropriately located or dimensioned glazing, or inappropriate glazing types, or a lack of features to bring the daylight further into the interior of the building;
- Occupants may be exposed to severe discomfort, due to excessive local overheating in West-facing spaces or glare in areas without adequate shading.

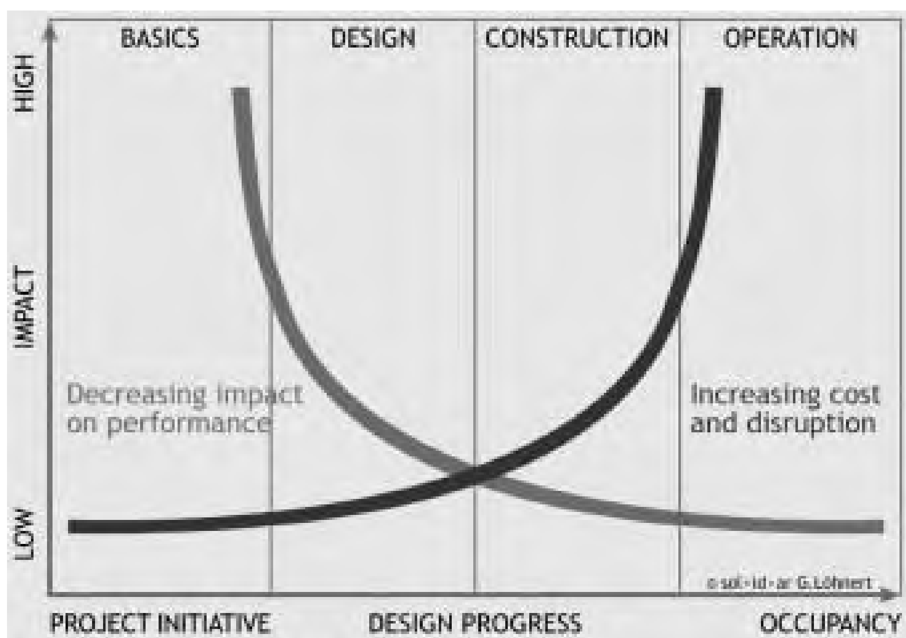
All these features are the result of a design process that appears to be quick and simple, but they result in high operating costs and create an interior environment that is substandard; and these factors in turn may greatly reduce the long-term rental or asset value of the property. Of course, since the conventional design process usually does not involve computer simulations of predicted energy performance, the resulting poor performance and high operating costs will come as a surprise to the owners, operators, or users.

If the engineers involved in such a process are clever, they may suggest some very advanced and high-performance heating, cooling, and lighting systems, but these may result in only marginal performance increases, combined with considerable capital cost increases. The underlying cause is that the introduction of high-performance systems late in the design process cannot overcome the handicaps imposed by the initial poor design decisions.

The problems outlined above represent only the most obvious deficiencies often found in buildings that result from the conventional design process. In summary, the conventional design process is not generally capable of delivering the high levels of broad-spectrum performance that are required in many contemporary projects.

The Integrated Design Process

The Integrated Design Process involves a different approach from the very early stages of design, and can result in a very different result. In the simplest of terms, the Integrated Design Process requires a high level of skills and communication within the team, involves a synergy of skills and knowledge throughout the process, uses modern simulation tools, and leads to a high level of synergy and integration of systems. All of this can allow buildings to reach a very high level of performance and reduced operating costs, at very little extra capital cost.



Source: Solidar, Berlin Germany

The Integrated Design Process is based on the well-proven observation that changes and improvements in the design process are relatively easy to make at the beginning of the process, but become increasingly difficult and disruptive as the process unfolds. Changes or improvements to a building design when foundations are being poured, or even contract documents are in the process of being prepared, are likely to be very costly, extremely disruptive to the process, and are also likely to results in only modest gains in performance. In fact, this observation is applicable to a large number of processes beyond the building sector.

Although these observations are hardly novel, it is a fact that most clients and designers have not followed up on their implications. The methods and tools developed in SHC Task 23, Optimization of Solar Energy in Large Buildings, represent the first international attempt to build on these facts and to develop a formalized process that will enable a large number of clients and designers to take advantage of them.

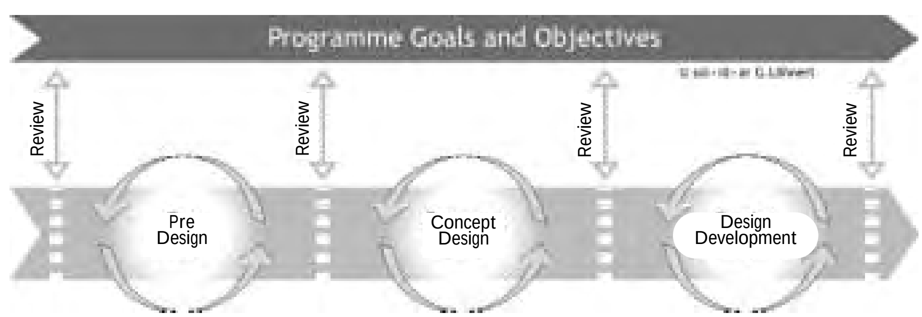
The Integrated Design Process includes some typical elements that are related to integration:

- Inter-disciplinary work between architects, engineers, costing specialists, operations people, and other relevant actors right from the beginning of the design process;
- Discussion of the relative importance of various performance issues and the establishment of a consensus on this matter between client and designers;
- Budget restrictions applied at the whole-building level, with no strict separation of budgets for individual building systems, such as HVAC or the building structure. (This reflects the experience that extra expenditures for one system, such as solar shading devices, may reduce costs in other systems, such as capital and operating costs for a cooling system.);
- The addition of a specialist in the field of energy, comfort, or sustainability;
- The testing of various design assumptions through the use of energy simulations throughout the process, to provide relatively objective information on this key aspect of performance;
- The addition of subject specialists (e.g., for daylighting, thermal storage, etc.) for short consultations with the design team;
- A clear articulation of performance targets and strategies, to be updated throughout the process by the design team; and
- In some cases, a Design Facilitator may be added to the team, to raise performance issues throughout the process and to bring specialized knowledge to the table.

Based on experience in Europe and North America, the overall characteristic of an Integrated Design Process is the fact that it consists of a series of design loops per stage of the design process, separated by transitions with decisions about milestones. In each of the design loops the design team members relevant for that stage participate in the process.

The design process itself emphasizes the following sequence:

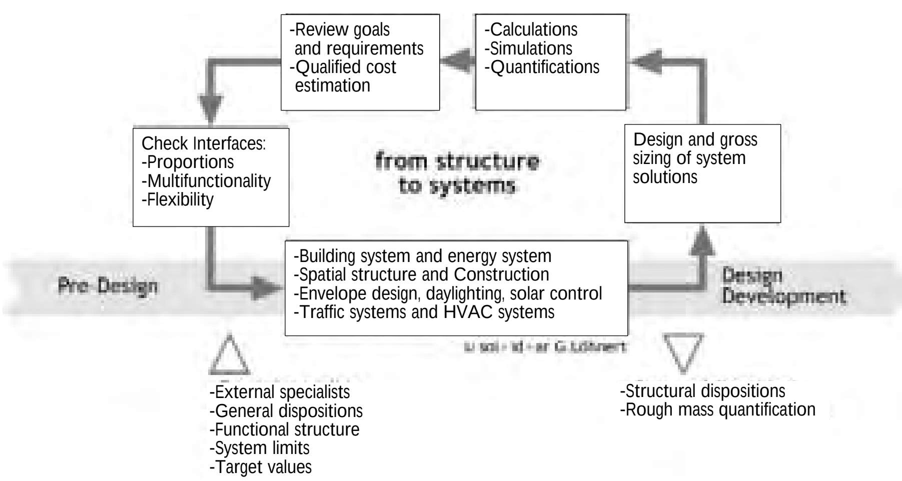
1. First establish performance targets for a broad range of parameters, and develop preliminary strategies to achieve these targets. This sounds obvious, but in the context of an integrated design team approach it can bring engineering skills and perspectives to bear at the concept design stage, thereby helping the owner and architect to avoid becoming committed to a sub-optimal design solution;
2. Then minimize heating and cooling loads and maximize daylighting potential through orientation, building configuration, an efficient building envelope, and careful consideration of amount, type, and location of fenestration;
3. Meet these loads through the maximum use of solar and other renewable technologies and the use of efficient HVAC systems, while maintaining performance targets for indoor air quality, thermal comfort, illumination levels and quality, and noise control; and
4. Iterate the process to produce at least two, and preferably three, concept design alternatives, using energy simulations as a test of progress, and then select the most promising of these for further development.



Source: Solidar, Berlin Germany

As an example a more detailed description of the design loop during the concept design phase is pictured. The central issue in this phase is to define systems in a conceptual way, based on the structure/scheme of the building. In a loop several options are considered, paying attention to the integration in the building as a whole, not just restricted to the technical aspects.

Integrated Design Process in the Concept Design Phase



Source: Solidar, Berlin Germany

The Integrated Design Process contains no elements that are radically new, but integrates well-proven approaches into a systematic total process. The skills and experience of mechanical and electrical engineers, and those of more specialized consultants, can be integrated at the concept design level from the very beginning of the design process. When carried out in a spirit of co-operation amongst key actors, this results in a design that is highly efficient with minimal, and sometimes zero, incremental capital costs, along with reduced long-term operating and maintenance costs. The benefits of the Integrated Design Process are not limited to the improvement of environmental performance. The experience of SHC Task 23 participants is that the open inter-disciplinary discussion and synergistic approach will often lead to improvements in the functional program, in the selection of structural systems, and in architectural expression.

The Integrated Design Process has impacts on the design team that differentiates it from a conventional design process in several respects. The client takes a more active role than usual, the architect becomes a team leader rather than the sole form-giver, and the mechanical and electrical engineers take on active roles at early design stages. The team should always include an energy specialist, and in some cases, an independent Design Facilitator.

The Success of the Integrated Design Process in Practice

The need for the guidelines, methods, and tools that were to be developed by SHC Task 23 was defined on the basis of experiences in a number of building projects characterized by a type of design process that was meant to facilitate integration. One of the projects studied is the Bentall Crestwood 8 Building in Richmond in British Columbia, Canada. Two office buildings were realized, alike in look and with comparable building cost. Yet one of them is about 30% more energy efficient than the other, and the amount of waste during construction was reduced by 50%. Compared to conventional buildings the energy use was even reduced by 50%. The building met the strict sustainability requirements from the C-2000 pro-

The Bentall Crestwood 8 Building in British Columbia, Canada

Photo by Bunting Coady Architects

ARCHITECT:
Bunting Coady Architects, Vancouver

HVAC ENGINEERS:
VEL engineering, Vancouver

ENGINEERS ENERGY/COMFORT:
D.W. Thomson Consulting Ltd.,Vancouver

FACILITATOR:
Canmet Energy Technology Centre, Ottawa

The Community Centre in Kolding, Denmark

Photograph by Municipality of Kolding

ARCHITECT:
White Architects A/S Copenhagen

HVAC/ENERGY/COMFORT/ELECTRICAL ENGINEERS:
Esbensen Consulting Engineers A/S Sønderborg

STRUCTURAL ENGINEERS:
Sloth Moller Consulting Engineers A/S

PROJECT MANAGER:
Kolding Municipality

MAIN CONTRACTOR:
NCC Denmark A/S

gramme. In order to achieve these results an interdisciplinary design team worked together right from the beginning of the design process. A design process facilitator supported the design team. This approach proved to be very successful.

Towards the end of SHC Task 23, some of the guidelines, methods, and tools developed were applied in demonstration projects with the focus on the Integrated Design Process. They illustrate the benefits of an Integrated Design Process and provide insights into some of the key issues it involves.

The first demonstration project completed was a Community Centre for the Municipality of Kolding in Denmark. The objective of this project was to create an overall solution for future buildings for all age groups and social stratums. Furthermore, the goal was to optimize the building in terms of resource use, functionality, and ecology. An Integrated Design Process was considered the most appropriate approach. In the competition phase a brainstorm workshop was organized among the architects and engineers in order to discuss and evaluate specific topics of integration. During the design process the SHC Task 23 multi criteria decision making method was used to help identify the objectives, to sort out poor solutions, and to document the design. Passive and active solar energy technologies are applied in the building, together with other sustainable features.

The efficiency of the process was a positive outcome of the Integrated Design Process. The client considered that the resulting good indoor climate and reduced energy operating cost were a direct result of using the Integrated Design Process. The client is in general very satisfied, and the team members intend to use the Integrated Design Process in future projects.

The Impact of Integrated Design Processes on Design

SHC Task 23 has shown that there are significant advantages in using Integrated Design Processes. Integration on the level of the process results in synergies at both the systems level and the whole-building level:

- Early discussion of the functional program and the project goals with the client, architect, and engineers may identify anomalies and ambiguities, and rapid clarification of this will lead to subsequent improvements in the functionality of the building;
- Careful orientation, massing, fenestration, and the design of shading devices can reduce heating and cooling loads, and will often improve thermal comfort;
- A high-performance building envelope will greatly reduce unwanted heat losses or gains, often to the point where heating or cooling systems are not required to operate at the perimeter of the building, resulting in capital cost savings and a gain in usable space;
- An emphasis on daylighting will reduce cooling loads, because of reduced lighting requirements, and may also improve illumination quality;
- These factors will permit a reduction in floor-to-floor heights (or improved daylighting because of higher net floor height), and will also permit a reduction in HVAC plant and system capacity and size requirements. Significant load reductions also open the way for use of alternative and simpler systems, such as radiant heating and cooling and natural or hybrid ventilation;
- Reductions in boiler, chiller, AHU, and ducting sizes will, in turn,

reduce capital, operating, maintenance, and replacement costs; and

- A deeper understanding of the nature and inter-relationships of all the issues described above, will lead to the possibility of a higher level of architectural expression.

The overall conclusion is that the Integrated Design Process has been shown in many case studies to result in high levels of performance, a superior indoor environment, and greatly reduced operating costs, at little extra capital cost. In order to achieve an integrated building in terms of performance and cost, a traditional design process is in many cases ineffective. Although there will always be individual designers who are able to design brilliant buildings in an individualistic way, the Integrated Design Process approach will be of significant benefit to most designers and clients who are attempting to achieve excellence in building design.

TASK 22:

Building Energy Analysis Tools

Michael J. Holtz
Architectural Energy Corporation
Operating Agent for the U.S. 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.
- 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 carried out research in the framework of two Subtasks during the initial phase of the Task:

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

During a Task Extension Phase, the Participants are focusing on two new Subtasks:

- Subtask C: Comparative Evaluation
- Subtask D: Empirical Validation

Tool evaluation activities will include analytical, comparative and empirical methods, with emphasis given to "blind" comparative evaluation using carefully designed test cases and "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 primary audiences for the results of the Task are building energy analysis tool developers and national and international building energy standard making organizations. 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.

Duration

The Task was initiated in January 1996, and with the approved 30-month extension, is planned for completion in June 2003.

ACTIVITIES DURING 2002

A summary of Subtask research activities completed during 2002 is presented below.

Codes and Standards Activities

A key audience for the research undertaken within this Task is national and international building energy standard making organizations. These organizations can use the test cases developed in Task 22 to create standard methods of tests for building energy analysis tools used for national building energy code compliance.

A significant achievement during 2002 is the publication of ASHRAE Standard 140-2001, which incorporates the IEA BESTEST suite of test cases (see Figure 1). ASHRAE Standard 140 has been given the status of continuous maintenance which means as new test cases become available from Task 22 and other sources they can be reviewed and integrated into a revised version of ASHRAE Standard 140.

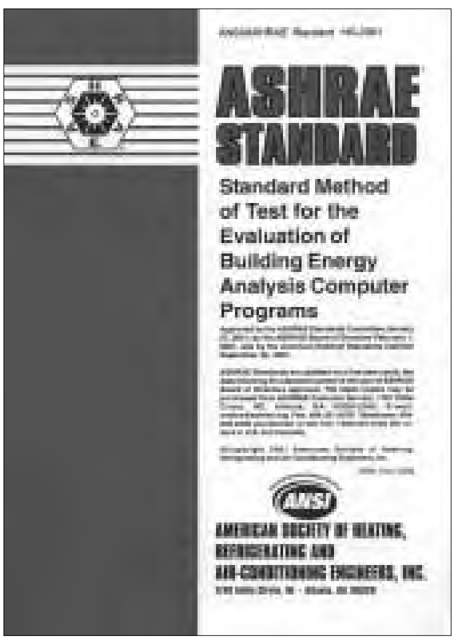


Figure 1.

Communication continues with a number of CEN Technical Committees, including 89, 156, 229, which are also addressing building energy calculation methods and the development building energy analysis tool test cases. Discussions were initiated during 2002 on how CEN and Task 22 can cooperate in the development and promulgation of test cases for evaluating building energy analysis tools.

Subtask C: Comparative Evaluation
This Subtask is concerned with developing a number of comparative tests on basic energy modeling capabilities. During 2002, Task Experts developed final test case specifications for the following energy modeling topics:

- Ground Coupling (from the original IEA BESTEST suite of test cases)
- Radiant Floor Heating Systems
- Gas-Fired Furnaces
- Mechanical Cooling: HVAC BESTEST – Cases E300-E545

Also, the Task Experts completed two to three rounds of test case analyses using the following building energy analysis simulations:

- DOE-2 (USA)
- TRNSYS (USA -- but as modified by TUD, Germany)
- IDA / ICE (Sweden)
- EnergyPlus (USA)
- CLIM2000 (France)
- ESPr (UK -- but as modified by NRCan, Canada)
- SUNRELgc (USA)

Figure 2 below shows the current state of agreement of five building energy analysis tasks for the HVAC BESTEST test cases.

In the process of conducting the analyses of the evaluation test cases, the Task Experts uncovered a number of algorithm and programming errors in the participating building energy analysis tools. Examples of errors or bugs found in the tools are as follows:

- DOE-2.1E – moisture / outside air modeling problems; low entering dry bulb modeling problem;

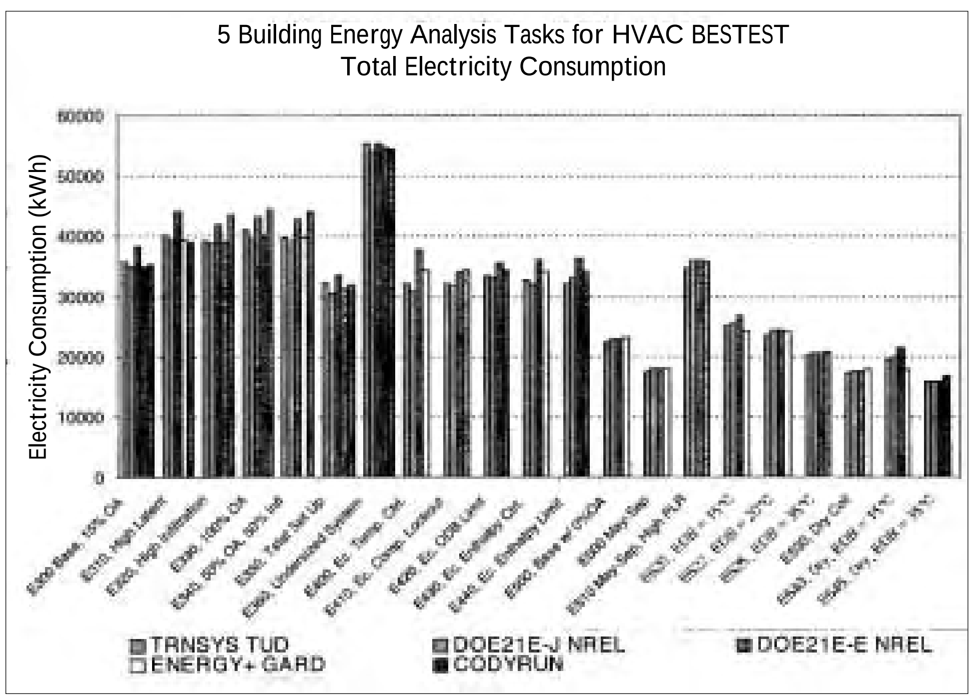


Figure 2.

- enthalpy limit economizer control modeling problem

- TRNSYS – weather data averaging problem

- EnergyPlus – missing algorithm regarding part-load operating influence on furnace efficiency; outlet condition calculation error for dry coils modeling problem; possible problem with economizer control algorithm

Subtask D: Empirical Validation
This Subtask is concerned with validating building energy analysis tool energy predictions with performance data from a highly controlled commercial test facility. The following energy systems will be tested in the Iowa Energy Resource Station Test Facility, with the performance data used in the validation of participating building energy analysis tools:

- Daylighting/HVAC Interaction
- Economizer Control

All data collection from the empirical validation experiments has been completed. Four rounds of tests were completed for the HVAC - Daylighting Interaction experiments (winter and summer solstice and fall and spring equinox) and four economizer control tests. The data from these tests, including weather data during the test period, have been processed and made available to the Task Experts through the Iowa Energy Resource Station web site. The Task Experts will compare their building energy analysis simulation results to these test data, and iterate as necessary to fully characterize any errors or limitations of the building energy analysis tools.

WORK PLANNED FOR 2003
Planned Task activities for 2003 are presented below.

Subtask C: Comparative Tests
Prepare and obtain Task Expert and Executive Committee approval of the following final reports:

- Building Energy Simulation Test and Diagnostic Method for Heating, Ventilation and Air-Conditioning Equipment Models (HVAC BESTEST): Cooling Equipment Test Cases E-300 - E545.
- Radiant Heating and Cooling Test Cases (RADTEST).
- Building Energy Simulation Test and Diagnostic Method for Heating, Ventilation and Air-Conditioning: Equipment Models (HVAC BESTEST): Fuel-Fired Furnace Test Cases.

Subtask D: Empirical Validation
Prepare and obtain Task Expert and Executive Committee approval of the following final reports:

- Specifications, Experimental Data, and Model Results for the Empirical Validation of Building Energy Analysis Tools for HVAC-Daylighting Interaction Tests.
- Specifications, Experimental Data, and Model Results for the Empirical Validation of Building Energy Analysis Tools for Economizer Control Tests.

With the completion and approval of these reports, Task 22 will end June 2003.

LINKS WITH INDUSTRY
Because of the nature of the Task – tool evaluation and emerging tool research – links with industry take a somewhat different form than other IEA SHC Programme Tasks. The primary audiences for Task 22 research are building energy analysis tool authors and national and international building energy standard making organizations. For tool authors, a number of links have been established. The Analytical Solutions Working Document was distributed for their use and comment, and a number of tool authors are participating in the HVAC BESTEST and Iowa Energy Resource Station tool evaluation exercises. These activities keep Task 22 research effectively linked to the needs and recommendations of the world's leading building energy analysis tool developers.

The results of Task 22 research are used as prenormative information in the establishment of national and international building energy codes and standards. For example, the IEA BESTEST cases were used by ASHRAE to develop a standard method of test for evaluating building energy analysis programs. Also, the U.S. National Association of State Energy Officials has referenced IEA BESTEST for certification of home energy rating software. A number of other countries, such as The Netherlands and Australia, are using BESTEST as a standard method of testing building energy analysis tools for their national energy codes or home energy rating software.

Through these kinds of industry

links, the participants of Task 22 ensure the valuable use of its research results.

REPORTS PUBLISHED IN 2002

Using Parameters Space Analysis Techniques for Diagnostic Purposes in the Framework of Empirical Model Validation.
Elena Palomo Del Barrio, LEPT-ENSAM and Gilles Guyon, EDF, December 2002

REPORTS PLANNED FOR 2003

Building Energy Simulation Test and Diagnostic Method for Heating, Ventilating and Air-Conditioning Equipment Models (HVAC BESTEST): Cooling Equipment Test Cases E300-E545.
National Renewable Energy Laboratory

Radiant Heating and Cooling Test Cases (RADTEST).
Hochschule Technik + Architektur Luzern

Building Energy Simulation Test and Diagnostics Method for Heating, Ventilating and Air-Conditioning Equipment Models (HVAC-BESTEST): Fuel-Fired Furnace Test Cases

Specifications, Experimental Data and Model Results for the Empirical Validation of Building Energy Analysis Tools for HVAC-Daylighting Interaction Tests

Specifications, Experimental Data and Model Results for the Empirical Validation of Building Energy Analysis Tools for Economizer Control Tests

MEETINGS IN 2002

Twelfth Experts Meeting
February 6-8
Ottawa, Canada

Thirteenth Experts Meeting
June 13-15
Bordeaux, France

Fourteenth Experts Meeting
December 9-11
Fontainebleau, France

MEETINGS PLANNED FOR 2003

Fifteenth Experts Meeting
April or May
Golden, Colorado, USA

TASK 22 NATIONAL CONTACT PERSONS

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

Australia
P.C. Thomas
Arup
Level 10
201 Kent Street
Sydney NSW 2000

Canada
Ian Beausoliel-Morrison
CANMET Energy Technology Centre
Natural Resources Canada
580 Booth Street, 13th Floor
Ottawa, Ontario K1A 0E4

Julia Purdy
CANMET Energy Technology Centre
Natural Resources Canada
580 Booth Street, 13th Floor
Ottawa, Ontario K1A 0E4

Finland
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
Joseph Ojalvo
Electricite de France, Department SEVE
Les Renardieres
Route de Sens, Ecuelles
77818 Moret-sur-Loing Cedex

Elena Palomo
LEPT-ENSAM
Esplanade des Arts et Metiers
33405 Talence Cedex

François Garde (observer)
LGI -- University of Reunion Island
IUT de Saint-Pierre
40 avenue de Saveto
97410 Saint Pierre

Thierry Mara (observer)
LGI -- University of Reunion Island
Faculté des Sciences of Technologies
15 Avenue René Cassion, BP 7151
97715 Ste. Clatilde

Germany
Clemens Felsmann and Gottfried Knabe
Technische Universität Dresden
Institut für Thermodynamik und Techn. Gebäudequsrüstung
Helmholtzstr. 14
01062 Dresden

Martin Behne
KLIMASYSTEMTECHNIK
Esdorn Jahn GmbH
Keplerstraße 8/70
10589 Berlin

The Netherlands
Wim Maassen (observer)
TNO Building and Construction Research
Postbus 49
2600 AA Delft

Wim Plokker (observer)
TNO Building and Construction Research
Postbus 49
2600 AA Delft

Spain
Juan Travesi
Departamento De Energías Renovables, CIEMAT
Avda. Complutense, 22
28040 Madrid

Sweden
Per Sahlin and Alex Bring
EQUA Simulation AB
(formerly Bris Data AB)
P.O. Box 1376
172 27 Sundbyberg

Switzerland
Gerhard Zweifel, Matthias Achermann, Reto von Euw, and Sven Kropf
Hochschule Technik + Architektur Luzern
Abt. HLK
CH-6048 Horw

United Kingdom
David Bloomfield, Foroutan Parand, and Elizabeth Silver
Building Research Establishment
Bucknalls Lane
Garston
Watford Wd2 7 JR

United States
Ron Judkoff
National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, Colorado 80401

Joel Neymark
J. Neymark & Associates
2140 Ellis Street
Golden, Colorado 80401

Gregory Maxwell and Simon Winata
Mechanical Engineering Department
Iowa State University
2025 Black Engineering Building
Ames, Iowa 50011

Curtis J. Klaassen
IEC Energy Resource Station
DMACC, Building 23
2006 S. Ankeny Boulevard
Ankeny, Iowa 50021

Bill Beckman (observer)
Solar Energy Laboratory
1500 Engineering Drive
University of Wisconsin
Madison, Wisconsin 53706

TASK 23:

Optimization of Solar Energy Use In Large Buildings

Anne Grete Hestnes
Norwegian University of Science and Technology
Operating Agent for the Research Council of Norway

TASK DESCRIPTION

The main objectives of Task 23 have been to ensure the most appropriate use of solar energy in each specific building project for the purpose of optimizing the use of solar energy and to promote an increased use of solar energy in the building sector.

This has been achieved by enabling the building designers to carry out trade-off analyses between the need for and potential use of energy conservation, daylighting, passive solar, active solar, and photovoltaic technologies in systematic design processes.

In addition, the objective of the Task has been to ensure that the buildings promote sustainable development. This has been done by including considerations of other resource use and of local and global environmental impact in the trade-off analyses to be carried out.

Scope

The work has primarily focused on commercial and institutional buildings, as these types of buildings clearly need several types of systems. In particular, office buildings and educational buildings have been addressed. The same issues are relevant for many other commercial and institutional buildings. However, some of these, such as for instance hospitals, require rather specialized design teams and would have broadened the scope of the Task tremendously. They have therefore been excluded from the Task in order to ensure concentration and focus in the work carried out.

Means

The work in the Task has been divided in four Subtasks:

- Subtask A: Case stories (Lead Country: Denmark)
- Subtask B: Design process guidelines (Lead Country: Switzerland)
- Subtask C: Methods and tools for trade-off analysis (Lead country: USA)
- Subtask D: Dissemination and demonstration (Lead country: Netherlands)

Subtask A provided the knowledge base to be used in the development of guidelines, methods, and tools in Subtasks B and C, while Subtask D has ensured that the results of the work are disseminated to the appropriate audiences.

Duration

The Task was initiated in June 1997 and was completed in June 2002.

Participation

A total of twelve countries have participated in the Task throughout its duration. They were:

Austria	Netherlands
Canada	Norway
Denmark	Spain
Finland	Sweden
Germany	Switzerland
Japan	USA

TASK ACCOMPLISHMENTS

The objectives of Task 23 have all been reached. The Task has enabled the designers to realize integrated design processes and to carry out the necessary optimization exercises, as it has provided these designers with a set of design tools. At the same time, the Task has ensured that the buildings designed using these tools promote sustainable development, as it has included criteria such as general resource use and local and global environmental impact in the analyses facilitated.

Subtask A: Case Stories
In Subtask A, a total of 25 buildings have been studied. As intended, both the processes used in the design of the buildings and the resulting performances were evaluated. The key issues in the evaluation of the design process were the design team organization and the availability of information. Potential obstacles were identified, and issues such as the risk and feasibility for investors and users of including low energy and solar technologies in the buildings to be designed were discussed.
The results of these studies confirmed the assumption that what was needed the most were guidelines for how to carry out integrated design processes and for how to do multi criteria decision making.

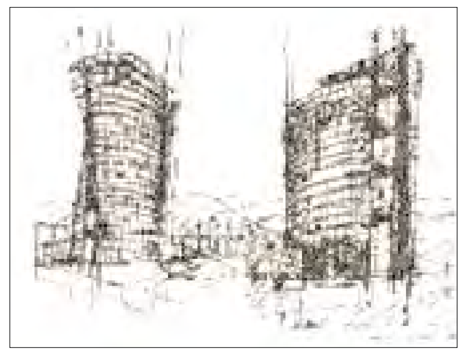
The results of the case studies have been documented in the report "Description of Case Stories" and in the booklet "Examples of Integrated Design". An article based on the first report was also produced and distributed to a number of journals. The article was in addition made into a colorful brochure that has been distributed at conferences and other events.

Subtask B: Design Process Guidelines
In Subtask B, guidelines for how to carry out integrated design processes have been developed. The conclusions of the work in Subtask A had indicated, as stated above, that it would be more important to develop design process guidelines than to develop traditional design guidelines (that give guidance about how to choose between different strategies and technologies during these design processes).

The results of the evaluation of the design processes used in the design of the case story buildings in Subtask A indicated both what the problems were and what information was required. The results of that work, together with an evaluation of existing guidelines, provided the basis for the development of the resulting Task 23 design process guideline.

The guideline developed is presented in a very large, comprehensive document that is only distributed in electronic form. It is accompanied by the Navigator, an electronic information space that serves as a guide through the design process.

During the development work, it was recognized that it would not be useful to only develop general guidelines in a form that could not be dynamically adapted for specific national requirements. The Navigator is therefore an environment for developing design processes for different contexts, and both national, company, and project versions may be developed. An external review of it carried out within the Task showed that it "would be a useful learning tool in any company and that the tool can be further developed over time using experience gained in the company."



A Task demonstration building in Germany. The Headquarters of the Deutsche Post AG, which is a 43 story building in the city of Bonn Germany.

Sketches by Helmut Jahn
(Murphy/Jahn Architect - Chicago)

Subtask C: Methods and Tools for Trade-Off Analysis
In building design, energy use and environmental impact are only two of the criteria important to the client. There are many others, and the relative importance of each of them will differ from case to case. In Subtask C, the experts therefore

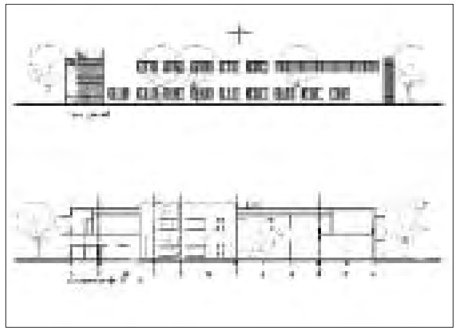
looked at tools that take into account any criteria chosen by a client and/or a design team and developed a multi criteria decision making method, called MCDM-23, and an associated computer program.

Basically, there are two situations where the MCDM-23 method should be used:

- In the process of designing a building:
  - when selecting and prioritizing among design criteria, and
  - when evaluating alternative design solutions.
- In a design competition:
  - when developing the program, and
  - when selecting the best design from among several submissions.

The MCDM-23 is a formalized step-by-step procedure to aid in such decision-making processes, while the computer program automates many of the tasks involved in using the method and produces worksheets, bar charts, and star diagrams.

The MCDM-23 was tested in local/national workshops on real design problems. In these situations, the participants experienced that the clients often were unaware of their own priorities with respect to the buildings they wanted to have built. The team workshops therefore helped both the clients and the others find out what they really wanted. The conclusion from testing the method was also that it proved to be a very valuable method in bringing the team together and in extending the range of issues being considered. Many have pointed to the importance of the method as "discussion making support" rather than as a "decision making method". I.e. its prime value lies in facilitating structured discussions and improving the transparency of decisions taken.



A Task demonstration building in the Netherlands – The Rabobank building in Zierikzee.

Two surveys formed part of the basis of the work in the Subtask. One described relevant existing computer tools, the other one described and discussed existing multi criteria decision making methods. Based on the survey of tools and on presentations and discussions of a few candidate tools at the expert meetings, the Task participants also decided that the computer program Energy-10 should be used as a Task 23 tool. Though Energy-10 is not developed within the Task, it fits the objective quite well. Therefore, national parameter sets for Energy-10 for the Task 23 countries were also prepared.

Subtask D: Dissemination and Demonstration

The assumption in the Task was that having demonstration buildings would be most effective in reaching builders, owners, and occupants. The development of demonstration buildings was therefore included as an option in the Task.

As expected, finding clients and funding for the construction of relatively large buildings within the timeframe of the Task turned out to be difficult. In the end, five buildings were constructed. They are:

- A Community Center in Kolding, Denmark
- A School in Mayo, Yukon, Canada
- The German Postal Service Headquarters, in Berlin, Germany
- The Rabobank office building, in Zierikzee, the Netherlands
- An office building for the Dutch Army, in Oirschot, the Netherlands

These buildings have served two purposes. They provided an opportunity to test the guidelines and tools developed, and they provided an effective way to demonstrate integration of technologies in real buildings and to promote "sustainable solar buildings".

Demonstration buildings are only one way of disseminating the results of the Task, however. The participants have been very active in disseminating the results in other ways – by organising seminars and workshops, by presenting the work at meetings and conferences, and by publishing the results in various national trade journals. As many of the Task participants are practitioners themselves, they have also, naturally, adopted the methods and tools in their own practices and have thereby also introduced others, i.e. their colleagues and project partners, to them. That way, the so-called "informal osmotic process," which in the long run is expected to have considerable effect, is working.

ACTIVITIES DURING 2002

As 2002 was the last year of the Task, the main activities mainly consisted of finalising the products developed, and of publishing and distributing them. A public website has been developed (www.iea-shc.org/task23), and all the documents have been placed on that site and can be downloaded. In addition, an introductory booklet explaining the characteristics of the integrated design process and introducing the results of Task 23 has been produced and printed. This document is also meant to serve as an introduction to the website.

Apart from that, the work on demonstration buildings has continued and will be continuing also beyond the time frame of the Task.

LINKS WITH INDUSTRY

Industry has naturally been involved in the design and construction of the demonstration buildings. This is not considered the most significant aspect of industry involvement in the Task, however. As the work focused on the development of methods and tools for use by the design community, i.e. for architects and engineers, the participation of architects and engineers from private practice was actively sought and achieved. Throughout the Task, the participation of such persons has been high. Of the 31 active participants in the Task, 15 are either owners of their own or senior members of private architecture or engineering companies.

A Task demonstration building in Canada – The Mayo School in the Yukon.

Photograph by Anja Thierfelder - Stuttgart

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Hestnes, A.G. and T.Esbensen, GBC'98, Vancouver, Canada.

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Integrated Design Approach for Sports Facilities
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Van Cruchten, G. (editor), Technical Report of Subtask D. Report available from EBM-consult, Arnhem, The Netherlands. 2001.

MEETINGS IN 2002

Tenth Experts Meeting
March 6-8
Yokohama, Japan

TASK 23 NATIONAL CONTACT PERSONS

Operating Agent
Anne Grete Hestnes
Faculty of Architecture and Fine Art
Norwegian University of Science and Technology - NTNU
N-7491 Trondheim
Norway

Austria
Susanne Geissler
Österreichisches Ökologie-Institut
Seidengasse 13
A-1070 Wien

Canada
Nils Larsson
Canmet Energy Technology Centre
13/F, 580 Booth St.
Ottawa, KIA 0E4

Denmark
Torben Esbensen
Esbensen Consulting Engineers AS
Møllegade 54-56
DK-6400 Sønderborg

Finland
Jyri Nieminen
VTT Building Technology
P.O. Box 1800
FIN-02044 VTT

Germany
Günter Löhnert
SOL.ID.AR
Forststrasse 30
D-12163 Berlin-Steglitz

Japan
Mitsuhiro Udagawa
Department of Architecture
Kogakuin University
1-24-2 Nishi-Shinjuku, Shinjuku-ku
Tokyo 163-8677

Netherlands
Bart Poel
EBM-consult
Box 694
NL-6800 AR Arnhem

Spain
Luis Alvarez-Ude Cotera
A.U.I.A., c/Papa Negro 41B
Parque Conde de Orgaz
E-28043 Madrid

Sweden
Maria Wall
Department of Building Science
Lund University, P.O. Box 118
S-22100 Lund

Switzerland
Pierre Jaboyedoff
SORANE SA
Route de Châtelard 52
CH-1018 Lausanne

United States
J. Douglas Balcomb
National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, Colorado 80401

TASK 24:

Solar Procurement

Hans Westling
Promandat AB
Operating Agent for Formas, the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning

TASK DESCRIPTION

The main objective of Task 24 is to create a sustainable, larger market for active solar water heating systems (mainly domestic systems). This objective will be achieved through major cost and price reductions for all cost elements, including marketing and installation, as well as performance improvements and joint national and international purchasing.

Subtasks

The work in Task 24 is divided into two Subtasks, each co-ordinated by a lead country:

- Subtask A: Procurement and Marketing
  (Lead Country: the Netherlands)
- Subtask B: Creation of Tools
  (Lead Country: Denmark)

The objectives of Subtask A are:

- To raise interest in active solar thermal solutions.
- To form buyer groups to purchase state-of-the-art and innovative systems.

The procurement activities have consisted of two rounds: the first with smaller national projects and a low degree of joint international collaboration, and the second with larger projects and a higher degree of collaboration.

The objectives of Subtask B are:

- To collect, analyse and summarise experience.
- To create tools to facilitate the creation of buyer groups and the realisation of projects and procurements. These tools will be included in a manual: "Book of Tools."
- To define a process for prototype testing and evaluation, using existing methods.

Participation

Six countries take part in the Task – Belgium (joined in 2002), Canada, Denmark, Netherlands, Sweden and Switzerland.

Duration

The Task was initiated on April 1, 1998 and will be completed on March 31, 2003.

ACTIVITIES DURING 2002

- The First Round of Task 24 ended in 2002 and much work has been spent on preparing for the Second Round of Task 24 procurements. Lots of activities have been ongoing in all the countries participating in Task 24. A summary is given below.

Belgium

Having participated as an observer for part of 2001, Belgium joined Task 24 in 2002. Several activities have been ongoing during the year. Tendering for the "Brussels Solar Water Heater Promotion Campaign" - grouped for 2 medium size installations (100 m^2 each) – started in May and was closed in September. Tenders submitted are now being evaluated and the supplier selection is ongoing.

The "Soltherm Wallonie" 10-year-programme, which was started in 2001, is made up of different sub-programmes, both for residential customers and for tertiary sector subgroups (hospitals, hotels, sports centres, etc). The sub-programmes include quality of supplier services, products and installation, professional training for installers and architects, general information and promotion. In the "Soltherm – Belsolar Quality System" project, 192 voluntary contracts for installation service quality were signed in 2001 and 12 suppliers have participated in 2002. Eight solar audits have been realised and 12 are well on their way. In the summer of 2002, there was an integration of the initiatives into one unified system for the Belgian market, the "Belsolar Quality System". Buyer groups are being prepared and the call for tender is planned for 2003. Much work is spent on having i.a. Quality Charter, collaboration with installers and technical criteria according to EN-Standards. Further information is available at www.soltherm.be.

Preparations started in 2002 for another project, "VLAZON," with the Belgian Solar Industry Association and the Flemish Regional Government. A strategic plan for market development will be drawn up and the position of buyer groups will be defined. Buyer groups will only be part of the implementation phase after finalisation of the strategic plan. A list of suppliers is available at Belsolar@3E.be.

Canada

In the two phases of the Canadian "Peterborough Green-Up and EnerACT (Energy Action Council of Toronto)" projects 43 systems have been installed and 3 more have been purchased. The projects have not been a total success and the installation schedules have not been met. Deregulation may have prevented utility participation in the marketing. Systems sold well with subsidies approaching 50% (Phase I), but sales proved more difficult with subsidies of approx. 25% (Phase II). The utility partners have now changed their operations to reduce service focus and more focus on marketing. Independent inspection and monitoring with integrating heat meters has begun on 20 of the systems. Detailed monitoring of beta systems will be implemented by January 2003.

A business plan has been developed for the new project "TEAM Advanced Low Flow Solar Water Heater", with two utilities in Ontario. The plan is to install 10,000 systems in 3 years. Initial testing has been completed at the National Test Facility. About 15 Beta test units have been installed this year and 40 systems have been contracted for installation by April 2003.

Commercial production is planned, including a manufacturing tender by August 2003.

A market research has been carried out in Canada and a report, "Survey to Gauge Awareness, Knowledge and Interest Levels of Canadians Toward Solar Domestic Hot Water Systems", was published in September. A number of issues important to increase the interest in solar systems on the market have been identified, such as raising awareness and removing uncertainties among households. The intension is upload an electronic version of the report at the Task 24 website.

Denmark

After a new Danish Government came into office in the autumn of 2001, there was a substantial reduction of the national renewable energy activities, including solar activities. The procurement buyer group project on the Internet, "www.soltilbud.dk", which started in August 2001, had to be discontinued at the year-end 2001 due to no new funding for the project. Although there were few buyers (people were not ready yet to buy from the Internet) but about 6,000 "hits", the website project can be regarded to have been a success since it offered much lower total prices for solar systems including installation, and it improved competition.

The "Sunshine over Thy and Morsø" project, which started in 1999 with two electric utility companies in Northwest Jutland, has sold 30 solar systems so far. A fusion between the utilities is coming up, and the utilities will probably continue to offer solar heating systems to their 45,000 customers. No direct mail campaign is planned, but there will be advertisements on their homepage.

The first steps in a new project were taken in the autumn of 2002. The project involves joint purchasing of solar collectors for district heating plants. A first meeting has been held in order to formalise the project and invitation letters have been sent out to about 30 district heating plants to investigate the interest potential. The objective of the project is to co-ordinate the efforts to install more solar heating to the local district heating plants. The idea is that the project team will carry out some actions for the plants, including investigation, preparation of detailed project and tender material, tendering, evaluation, and assist in installation, supervision and delivery. Concentration is made at first on smaller plants, since the larger ones can manage the actions by themselves.

Netherlands

In the Netherlands, Task 24 has influenced the market to a large extent and has also assisted in introducing the European Standards. Several projects have been ongoing in 2002, for domestic systems and for medium-size systems. In the "Space for Solar", which is a framework turnkey delivery contract project for medium-size systems with housing associations, quick scans have been conducted for 3,400 m^2. Conversion to individual contracts is ongoing, but it is a laborious process. Currently 9 systems with a total area of 614 m^2 have been realised.

In the "Solar Energy in the Essent Supply Region" project for domestic systems for new houses, 3 suppliers were selected. They are companies that also sell heating equipment. 33 new housing projects with a total of 2,223 dwellings have been registered. In 1,240 of them solar systems will be installed. 710 systems have been installed so far and 530 systems are planned to be realised 2003-2004.

In the "Call the Sun" project with the ASN Bank, WWF and SOL*id, the systems are mainly sold through 2 campaigns, one in 2001 and the other in 2002. In 2001, 200 SWHs and 2,150 panels were installed, and in 2002 5 municipality campaigns have been finished with 450 SWHs and 100 PVs. Campaigns are ongoing in several Dutch regions and cities, including Rotterdam, Amsterdam and The Hague.

The "WWF Solar Dwellings" project is a market introduction project. The buyer group consists of 19 property developers. Up to October 2002, 600 houses have been contracted. A feasibility study has been drawn up, based on the WWF solar dwelling quality certificate requirements. Performance specifications have been set up for solar thermal, PV and heat pumps, and the call for tenders was launched in March 2002. The tenders submitted were evaluated in May-June. A second negotiation round started in October and products are planned to be on the market in late 2002.

Sweden

In Sweden, two projects were launched in 2000 – a procurement for medium sized systems (10,000 m^2) and a competition for small systems (5,000 – 10,000 m^2). The calls for tender were published both nationally and internationally via the EU Official Journal. All information about the projects, including competition documents (in Swedish and English), has been available on the Internet site: http://solupphandling.bfr.se. About a dozen entries (including 3-4 international ones) were received in both projects.

The procurement for solar collectors for use in medium sized systems had to be discontinued since sufficient volumes for signing contracts with successful suppliers were not achieved. Favourable lower costs had been guaranteed only on condition that there was to be a specified amount of guaranteed deliveries.

In the competition for small systems, Internet was used to register the buyer-group. A Swedish company, a subsidiary of a Finnish industry group, was selected winner. Its prototype system was tested and 5 pilot installations were made in 2001. The market introduction of the system was somewhat delayed due to material problems in these installations. After further development of the equipment material, retesting was made, including field-testing in Australia and laboratory testing in Sweden of components and systems. The testing was finalised with good results, and at the beginning of April 2002 decisions were taken by the competition jury to approve the system for start of deliveries. 1,000 systems are to be delivered, and from May – September 2002, 150 systems were delivered. The remaining 850 systems will be delivered up to April 2003. No complaints have been heard after field-testing during the extreme hot Scandinavian summer this year. Only positive comments have been given as to easy system mounting and good instruction manual.

A Final Report about the Swedish projects has recently been now drawn up. It is written in Swedish, but will be translated into English and made available to all Task 24 participants. Important "lessons learned" include the importance of international announcement of a project, specifications and competition documents should be drawn up in an international language and should be easy accessible, uploaded on the Internet, for example.

Switzerland

In Switzerland the solar projects were somewhat delayed as a consequence of the referendum in 2000, which was not in favour of solar project follow-ups. However, in 2002 several activities have been ongoing. The "100 Solar Roofs in Lucerne" project was started in May with the City of Lucerne as project responsible and coached by the Swiss Task 24 representatives. Business partners are the Energy and Water Works. Replacement of heating (fuel switch oil – gas and standard hot water installations) has been made during the autumn of 2002 and the project will end in the summer of 2003.

Two projects have been prepared in 2002: the "Action Flumrock/Rüesch Solar" project and the "SSES Virtual Buyer Group (on the Internet)" project. A new project "Solar Showers" started in Basel in August and ended in October. It was an information project from the Basel District Government with free consultancy. Installers were given information and training to become executive partners as "Solarprofis" (solar professionals). Interested solar buyers received a voucher for a consultation with one of the trained installers. It was a remarkable success with installers as partners and consultants. More than 60 installers received information and training.

In the "Solar Roofs for Zürich" project with Swissolar and the Canton authorities as partners, very long discussions have been going on since April 2002. The intention is to have a fuel switch combined with solar (gas utilities). A presentation of Task 24 was made at the end of November with information about tools, manuals etc.

The “Solar Manual”, which has already been tested, was distributed in October. A two-page leaflet “Solar – ja klar!” was also produced in 2002. It describes with pictures how a solar system can be installed in just one day – beginning at 7 a.m. and ending at 6.30 p.m.

European Union

In addition to the national activities mentioned above, eleven European Union countries have started collaborative work in the “Soltherm Europe Initiative” for domestic systems for new houses. The strive for more international procurement within the solar field initiated in Task 24 has continued with this project. The supplier organisations ASTIG and DFS are partners in the project. The performance specifications are based on EC quality standards. An EU Altener contract was signed in January 2002. National implementation planning is currently ongoing. The goal is to have 100 million m^2 installed by 2010. Further information is available at www.soltherm.org.

Task Website

In Subtask B, the Task 24 website has, after a delay due to uncertain funding, been further elaborated during the last part of 2002. Additional material has been included and more will be uploaded in 2003.

WORK PLANNED FOR 2003

As the Task will end on March 31, 2003, the activities will mainly consist of finalising the ongoing projects.

- The Task 24 website (www.ieatask24.org) will be updated, in particular the "Business Tools" section. Tender and contract documents, case descriptions, campaign guidelines, spreadsheets and relevant brochures and marketing material will be uploaded.

- The final report on the Swedish projects will be translated into English and will be uploaded at the Task 24 website.

- When completely finished, the Task 24 website will be transferred to the server hosting the IEA SHC website http://www.iea.org.

- Presentation about Task 24 will be given at the ISES conference in Gothenburg, Sweden, in June 2003.

- The experience derived from the activities in Task 24 will be included in the Final Management Report, which will be prepared by the Operating Agent after the end of the Task.

LINKS WITH INDUSTRY

Task 24 has stressed the importance of having a dialogue with suppliers, including manufacturers, retailers and distributors. At various meetings, international and national conferences and workshops, the market parties have been informed about the Task work. Brochures have been sent out and information has been supplied on the different national websites and on the Task 24 homepage.

A dialogue was initiated with the two European supplier organisations ASTIG and ESIF, and the Task 24 draft tender documents were sent to them for their comments. There have been several contacts with ASTIG in this matter. The Quality Guidelines, drawn up jointly by ASTIG and Ecofys in the Netherlands, will be an important part in future tender documents. In 2002, the Task 24 Subtask A Leader was formally appointed contact person with ASTIG as he already had established good contacts with this organisation. It is expected to be more integration between ASTIG and ESIF after their merger into the European Solar Thermal Industry Federation at the beginning of 2003.

REPORTS PUBLISHED IN 2002

Book of Tools, the third edition of the Task 24 report produced on the web with the majority of the original content in the section "Business Tools" was published in 2002. The report is available on the Task web site (www.ieatask24.org).

Survey to Gauge Awareness, Knowledge and Interest Levels of Canadians Toward Solar Domestic Hot Water Systems
published by Canada.

Solar Manual
published by Switzerland for buyer groups.

A report about on the Swedish activities was finalised in December 2002 in Swedish and will later be translated into English.

REPORTS PLANNED FOR 2003

Book of Tools
final version to be available on the Task 24 web site.

MEETINGS IN 2002

Ninth Experts Meeting
March 21-22
Denmark

Tenth Experts Meeting
October 15-16
Belgium

MEETINGS PLANNED FOR 2003

Eleventh Experts Meeting
March 20-21
Canada

TASK 24 NATIONAL CONTACT PERSONS

Operating Agent
Hans Westling
Promandat AB
P.O. Box 24205
SE-104 51 Stockholm
Sweden

Belgium
Luc De Gheselle
3E nv.
Verenigingsstraat 39
B-1000 Brussel

Canada
Doug McClenahan
CANMET/Natural Resources Canada
580 Booth Street
Ottawa, Ontario K1A OE4

Michael Noble
EnerWorks
280 Cheapside Street
London, Ontario, N6A 2A2

Denmark
Klaus Ellehauge
Vestergade 48 H
DK-8000 Aarhus C

Torben Esbensen and Lotte Gramkow
Esbensen Consultants A/S
Mollegade 54
DK-6400 Sonderborg

The Netherlands
Peter Out and Frank Zegers
Ecofys Research and Consultancy
P.O. Box 8408
NL-3503 RK Utrecht

Sweden
Hans Isaksson
K-Konsult Stockholm
P.O. Box 47044
SE-100 74 Stockholm

Switzerland
Markus Portmann
BMP Sanitär und Energie
Kirchrainweg 4
Postfach
CH-6011 Kriens

Christian Vollmin
SSES, Swiss Solar Energy Society
c/o Sopra Solarpraxis AG
Hombergstrasse 4
CH-4466 Ormalingen

TASK 25:

Solar Assisted Air Conditioning of Buildings

Hans-Martin Henning
Fraunhofer Institute for Solar Energy Systems ISE
Operating Agent for the German Federal Ministry of Economics and Labour (BMWi)

TASK DESCRIPTION

The main objective of Task 25 is to improve conditions for the market introduction of solar assisted air conditioning systems in order to promote a reduction of primary energy consumption and electricity peak loads due to air conditioning of buildings. Therefore the project aims on:

- Definition of the performance criteria for solar assisted cooling systems considering energy, economy and environmental aspects,
- Identification and further development of promising solar assisted cooling technologies,
- Optimization of the integration of solar assisted cooling systems into the building and the HVAC system focusing on an optimized primary energy saving - cost performance, and
- Creation of design tools and design guidelines for planners and HVAC engineers.

The work in Task 25 is carried out in the framework of four Subtasks.

Subtask A: Survey of Solar Assisted Cooling

The objective of Subtask A was to provide a picture of the state-of-the-art of solar assisted cooling. This includes the evaluation of projects realized in the past.

Subtask B: Design Tools and Simulation Programs

The objective of Subtask B is to develop design tools and detailed simulation models for system layout, system optimization and development of advanced control strategies of solar assisted air conditioning systems. Main result will be an easy-to-handle design tool for solar assisted cooling systems dedicated to planners, manufacturers of HVAC systems and building engineers.

Subtask C: Technology, Market Aspects and Environmental Benefits

The objectives of Subtask C are to provide an overview on the market availability of equipment suitable for solar assisted air conditioning and to support the development and market introduction of new and advanced systems. Design-guidelines for solar assisted air conditioning systems will be developed.

Subtask D: Solar Assisted Cooling Demonstration Projects

Several demonstration projects will be carried out and evaluated in the framework of Task 25. The objectives are to achieve practical experience with solar assisted cooling in real projects and to make data for the validation of the simulation tools available. Aim is to study the suitability of the design and control concepts and to achieve reliable results about the overall performance of solar assisted air conditioning in practice.

Duration

The Task was initiated in June 1999 and will be completed in May 2004.

ACTIVITIES DURING 2002

Important activities of the whole Task in the year 2002 were:

- Production of a solar assisted desiccant cooling demonstration model for trade fairs and similar events.

- Participation at the Light & Building Trade Fair in Frankfurt/M. (Germany) in April 2002 with a stand presenting Solar Assisted Air Conditioning Techniques (jointly with Fachinstitut Gebäude-Klima, a German association of air conditioning companies).
- Intensive work on the Handbook for Planners

A summary of Subtask research activities carried out during 2002 is presented below.

Subtask A: Survey of Solar Assisted Cooling

Subtask A work was completed in 2001.

Subtask B: Design Tools and Simulation Programs

Mathematical models for all key components of solar assisted air conditioning systems have been developed: single-effect absorption chiller (with mechanical solution pump and with bubble pump), double-effect absorption chiller, adsorption chiller, desiccant wheel and system, solar collectors, storage tank, backup gas heater, cooling tower and other standard air handling equipment components. Most of the component models have been implemented in the design tool and most of them (e.g. thermal driven chillers) have also been written as component models for TRNSYS. A beta-version of the WINDOWS design tool is available which is recently to be tested by Task participants. Three typical building loads were defined (office building, hotel, lecture room) as well as 7 climatic areas which cover the whole spectrum from warm-humid to moderate climates (Tropical, Mediterranean/Coastal, Mediterranean/Inland, Central European/South, Central European/Moderate and Central European/North). Reference load files for all combinations of load and climate (21 files) were produced.

Subtask C: Technology, Market Aspects and Environmental Benefits

A survey of market available equipment for solar assisted air conditioning was carried out. It will contribute to the Handbook for planners, which will be a major output of the Task. Also, a survey on finished and ongoing national R&D work on new components was carried out and a technical report was produced. In addition, an approach to determine overall performance of solar assisted air conditioning systems with relation on energy, economy and environmental issues was developed.

Subtask D: Solar assisted cooling demonstration projects

Twelve demonstration projects are part of Task 25. Nine systems were started or continued operation in 2002. There is an ongoing monitoring programme and the first results (e.g., monthly energy balances and solar contributions to air conditioning) are available.

WORK PLANNED FOR 2003

Subtask A has been completed. And, Subtasks B and C were extended until the end of 2002. The main work for 2003 is to finish the handbook

Solar desiccant cooling demonstration system presented at the Light & Building Trade Fair in Frankfurt, Germany in April 2002. The system will be presented again at the Light & Building Trade Fair in Abu Dhabi in January 2003 and design tool, and to continue the work of Subtask D. The Subtask D work includes final commissioning of the demonstration systems that are not yet in operation and the continued monitoring and evaluation of results. Furthermore, additional work was defined as follow-up in Subtasks B and C. The new work addresses design tool validation and optimized system control (Subtask B), and new work on dissemination and promotion including conducting a market study to identify the most promising niches for the introduction of solar assisted air conditioning in the market (Subtask C).

Trade Fair Participation

The demonstration model, which was produced for demonstration of solar assisted desiccant systems at trade fairs, will be shown in the Light & Building Trade Fair in Abu Dhabi, United Arab Emirates in January 2003. Special Posters for design of systems for climatic regions like in coastal areas of the Persian Gulf will be prepared.

REPORTS PUBLISHED IN 2002

A technical report on ongoing research relevant for solar assisted air conditioning systems was produced and is under review.

REPORTS PLANNED FOR 2003

Solar Assisted Air Conditioning Handbook.

This handbook is one of the major outputs of the Task and will summarize the work of Subtask C and parts of Subtask B. The target audiences of the handbook are planners, manufacturers of A/C systems and building engineers.

MEETINGS IN 2002

Sixth Expert Meeting
April 18-20
Freiburg, Germany

Seventh Expert Meeting
October 14-15
Graz, Austria

MEETINGS PLANNED FOR 2003

Eighth Expert Meeting
April 3-4
Palermo, Italy

Ninth Experts Meeting
To be determined

TASK 25 NATIONAL CONTACT PERSONS

Operating Agent
Hans-Martin Henning
Fraunhofer Institute for Solar Energy Systems ISE
Heidenhofstr. 5
D-79100 Freiburg
Germany

Austria
Wolfgang Streicher
Technical University Graz
Inffeldgasse 25
A-8010 Graz

France
Jean-Yves Quinette
(Leader Subtask D)
Tecsol
105, rue Alfred Kastler - Tecnosud - B.P. 434,
F-66004 Perpignan

Germany
Uwe Franzke
(Leader Subtask B)
Institut für Luft- und Kältetechnik
Bertolt-Brecht-Allee 20
D-01309 Dresden

Greece
Constantinos A. Balaras
Group Energy Conservation
IERSD, National Observatory of Athens
Metaxa & Vas. Pavlou
R 15236 Palea Penteli

Israel
Gershon Grossman
Technion Haifa
Haifa 32000

Italy
Federico Butera
Politecnico di Milano
via Bonardi, 3
20133 Milano

Japan
Hideharu Yanagi
Mayekawa MFG.Co., LTD.,
2000, Tatsuzawa Moriya-Machi,
Kitasoma-Gun
Ibaraki-Pref. 302-0118

Mexico
Wilfrido Rivera
Universidad Nacional Autonoma de Mexico
Apdo. Postal #34 Temixco 62580
Morelos

Netherlands
Daniel Maron
TNO Building & Construction Research
Schoemakerstraat 97, P.O. Box 49
2600 AA Delft

Portugal
João Farinha Mendes
DER / INETI, Edificio G
Estrada do Paco do Lumiar, 22
1649-038 Lisboa

Spain
Carlos David Pérez Segarra
Universitat Politècnica de Catalunya
C/ Colom, 11
E-08222 Terrassa (Barcelona)

TASK 26:

Solar Combisystems

Werner Weiss
AEE, Arbeitsgemeinschaft
ERNEUERBARE ENERGIE
Institute for Sustainable Technologies
Operating Agent for the Austrian
Ministry of Transport, Innovation and
Technology

TASK DESCRIPTION

Solar heating systems for combined domestic hot water preparation and space heating, so called solar combisystems are increasing their market share in several countries.
Much is already known about solar domestic hot water systems, but solar combisystems are more complex and have interaction with extra subsystems. These interactions profoundly affect the overall performance of the solar part of the system. The general complexity of solar combisystems has led to a large number of widely differing system designs, many only very recently introduced onto the market. After the first period of the use of combisystems (1975-1985), when design of non standard and complex systems by engineers was the rule, a new period has been opened since 1990. Now the design is done essentially by solar companies trying to sell systems which are less complex and cheaper. But current designs result mainly from field experiences and they have not yet been carefully optimized. Substantial potential for cost reduction, performance improvement and increase in reliability exists and that needs to be scientifically addressed.

Scope and Main Activities

Task 26 is reviewing, analyzing, testing, comparing, optimizing and improving designs and solutions of solar combisystems for:

- detached single-family houses,
- groups of single-family houses, and
- multi-family houses or equivalent in load with their own heating installations.

This Task does not refer to solar district heating systems, systems with seasonal storage and central solar heating plants with seasonal storage.

To accomplish the objectives of the Task, the Participants are carrying out research and development in the framework of the following three Subtasks:

- Subtask A: Solar Combisystems Survey and Dissemination of Task Results
 (Lead Country: Switzerland)
- Subtask B: Development of Performance Test Methods and Numerical Models for Combisystems and their Components
 (Lead Country: The Netherlands)
- Subtask C: Optimization of Combisystems for the Market
 (Lead Country: Austria)

Besides 37 experts from 10 countries, 16 companies from almost all the participating countries are taking part in the work. Their contributions will make the results of the Task more relevant to the solar heating industry in general.

Duration

The Task was initiated on December 1, 1998 and will be completed on December 31, 2002.

ACTIVITIES DURING 2002

A summary of Subtask research activities during 2002 is presented below.

Subtask A: Solar Combisystems Survey and Dissemination of Task Results

In the area of combisystem characterization the scheme named FSC Procedure, introduced by the French participant has turned up to become a major powerful tool for solar combisystems. The FSC scheme has similarities with f-chart, the well-known design tool for solar water heaters. Data from Subtask C have been used to characterize some 10 generic systems. The characteristic functions obtained for each of them are the main background information for a simple design tool for architects and engineers. With this tool, solar combisystems can be compared and properly sized according to specific requirements from the practice. Two different versions are currently under development in Sweden and France for two different target audiences.

The Norwegian combisystem has now been entered into the classification in the Task's published colored booklet "Overview of combisystems 2000," as generic System #9b. Norway, who joined Task 26 late, prepared a full description of its system. This text has been incorporated to the booklet on the IEA SHC web site. No renewed printing of the booklet is foreseen.

Norwegian solar combisystem. The solar collector is a modular building element, which is available in various lengths and replaces standard roof- or facade covers. The collector consists of a polycarbonate twin-wall sheet as collector cover and polyphenylen-based absorber with intrinsic structure.

The compiled information on space requirements of generic combisystems (storage tank(s), pump/hydraulics, external boiler, external heat exchanger) has been supplemented and is now available for the final Task deliverables. Regarding the cost of solar combisystems, there is a problem. Task 26 passed the message last year to the parallel running EU Altener project aiming at disseminating the Task 26 results. However, due to the delayed starting of the Altener project in 2001, the new cost data expected by Task 26 from the Altener project will not be available to Task 26 before its completion in 2002. Cost analysis and cost/performance considerations within Task 26 will therefore be limited.

Architectural integration of combisystems, especially into south-facing walls, is being tackled by the Austrian and Norwegian participants. Long-term measurements inside several such facades with built-in collectors have indicated that no problems are encountered with moisture in the wall, provided that no moisture barrier is put on the inner side. The collectors act as a warm moisture barrier and vapor has to escape from the inner side of the wall. Even if the collectors do not deliver any usable heat to the storage tank, they significantly reduce the heat transfer through the wall and reduce in this way the heat demand for space heating. Overheating in summer is not a problem.

Solar combisystem with 22.7 m^2 façade-integrated collector in Austria

Subtask A has been discussing aspects of reliability and durability. It considered the risk of wrong installation for solar combisystems and the risk of failure of their components, especially the conventional ones like pumps, valves and sensors. The analysis considered the generic combisystems of the Task 26 colored booklet; each of them has a different number of components subject to potential failures. Finally, a detailed analysis of the conditions prevailing when the collector's liquid content is brought to boiling point, led to recommendations for an efficient overheating protection in a solar combisystem. They include the design of rapidly emptying collectors (under the action of the boiling liquid in the absorber) as well as the drainback technology.

The compilation of resource documents on solar combisystems available in the participating countries is on going.

The Task 26 final deliverable will be a Design Handbook to be published by James & James. The title will be: Solar Heating Systems for Houses – A Design Handbook for Solar Combisystems. Under the co-ordination of the Operating Agent with the help of Subtask A participants, the whole Task 26 is currently preparing the different book chapters. At the same time, the Technical Reports are being posted on the Task web site. All the Task 26 results will be found either in the Handbook or in the Technical Reports.

The third and last issue of the annual Industry Newsletter will be distributed in January 2003. Besides general information on Task 26 and its Final Deliverables, it will give news from the Altener project on solar combisystems which operated in parallel to Task 26, announce the national workshops for the dissemination of Task 26 results (Altener project), and present three articles on drainback systems (the Netherlands), the FSC Procedure (France) and the market development in the participating countries since 1997 (Austria).

The last Industry Workshop was held in Oslo on April 8, 2002. It was honored by the presence of Mrs. Brit Skjelbred, Deputy Minister of Oil and Energy of Norway, who made a presentation about "Solar energy in the Norwegian energy policy." The addressed topics were solar energy in the energy political context of Norway, solar combisystems with gas as auxiliary energy sources, and architectural aspects of active solar heating systems. As usual, the workshop proceedings are available from the Task 26 web site.

Subtask B: Development of Performance Test Methods and Numerical Models for Combisystems and their Components.

Test method development for solar combisystems includes both thermal and hot water performance. Model development supports both test procedure development and evaluation of tests in Subtask B and optimization of solar combisystems in Subtask C. As model development has mainly taken place in conjunction with system optimization in Subtask C, reference is made to the progress of Subtask C. Specific model development was carried out for investigation of simulated test data.
Five countries have been working on test procedure development: France (CSTB), Germany (ITW), Sweden (SERC and SP), Switzerland (SPF) and The Netherlands (TNO).

Thermal Performance Test Method
The Direct Characterization (DC) test procedure for determination of thermal performance of solar combisystems has developed further. A third and later fourth version of the test procedure was drafted. The drafts consist of test facility layout, description of tests including conditions and data processing.

In the test method description, it is recommended that auxiliary heating is part of the solar combisystem. Many problems in system operation appear to be due to improper control strategy of combination of solar and auxiliary part of the system. Hence, the test method forces manufacturers to think about integral system design. However, in some cases it is more practical to use an Auxiliary Heating Emulator (AHE). This laboratory heater is part of the test facility and can act as indirect boiler when the solar combisystem has an integrated auxiliary part, or can deliver the remaining of the heat demand to space heating and domestic hot water after solar preheat.

The other heat source is the sun that is simulated through a solar simulator or a heater controlled by a solar collector efficiency curve or a combination of both. Tilt angle for the collector shall always be 450C, i.e. for all three climates selected.
In the present description of the DC test procedure, space heating distribution system is emulated. By doing so, influence of specific control strategies is taken into account to a lower extend. Auxiliary heating in the test might act quite differently than in real operation. This is a consequence of the simplification already known. However, with implementation of the test conditions into the test facilities, differences are minimized so that operation of the solar combisystem is as realistically as possible.

Test conditions were investigated and applicability range of the method was investigated using simulated tests. Applicability range of the test method turns out to be solar combisystems smaller than 15 - 20 m² collector area and 1500 - 2000 liters heat store volume. In these cases, the prediction in the annual system performance error due to the method remains smaller than 5%. Discussion on the fourth draft revealed some recommendations for improvement.

A more complex test method in which the house is simulated on line, the 12 day Concise Cycle Test, has been tried out in Switzerland for product optimization. Result is that a lot of solar combisystems do not operate as intended.

Another major result presented was validation of the more complicated CTSS method. A 6.5 m² - 650 liter solar combisystem tested some two years ago, was installed and monitored. The model resulting from CTSS appeared to describe the behavior of the system in practice excellently.

Test Facilities and Thermal Performance Testing

Test facilities are ready now at ITW (Germany), SP (Sweden) and SPF (Switzerland). And, test facilities at CSTB (France) and TNO (The Netherlands) are underway. Earlier this year, both ITW and SP tested two solar combisystems according to CTSS and earlier drafts of the DC test method. Recently, SFP tested systems according to the CCT test method. About to start are tests in France (Viessman system) and in the Netherlands (ATAG, Daalderop and ZEN system).

Subtask C: Optimization of Combisystems for the Market

The objective of this Subtask is to enhance existing solar combisystem designs by optimization based on simulation of the systems and to help industry to propose new system designs being able to match demand with better thermal and economical performance than before. Nine of the 21 system designs chosen by Subtask A are modeled. The optimization of the models is finished and the description of the 9 systems including modeling and the optimization will be presented in the technical reports of Subtask C. One system was improved (#9) using the subtask C results and another system is not an more present on the market (#18).

The reference conditions for simulation runs are defined in Milestone Report CO_2 and approved by the participants. They are based on four reference buildings (single family house with 30, 60 and 100 kWh/m²a space heat demand), three climates (Stockholm, Zurich, Carpentras), conventional reference systems and many fixed parameters. Again the reference conditions had to be slightly changed. The target functions had to be adjusted to electrical auxiliary heaters as they are used in system #9b in Norway and the reference conditions of the multi-family building needed to be slightly changed. These alterations do only effect systems #9b and #19.

The optimization procedure is described in Milestone Report C3.1 and was finally approved at the October 2001 Experts Meeting.

Three energetic target functions have been developed. There was no change in the last year on the optimization procedure.

The material demand was delivered for 4 different systems until the last experts meeting. A brief analysis showed, that a comparison will be very difficult because some systems include the burner, others not, some systems need a floor heating system others do with radiators. In order to deliver a report taking into account the limited timeframe left, it was agreed on the following procedure: The subtask leader will accumulate the data and send it back to the participants for analysis of their own systems in respect to the others. The subtask leader will summarize the results an will write a final report by December 2002.

The procedure of the comparison of the systems presented by ASDER (France) was tested by the participants and gives very encouraging results. With this method it is possible to compare systems in different ranges of fractional energy savings ('large' solar plants against 'small' solar plants) basing on the efficiency of the system (maximum possible solar energy yield for the used collector area against actual yield). This comparison will be part of the design handbook of Task 26.

As the optimization work was finished in October 2002 and the descriptions will be finished by December 2002.

Two participants will deal with the matter of dream systems. They will produce a report at the end of 2002.

LINKS WITH INDUSTRY

Sixteen companies from almost all the participating countries are taking part in Task 26. The Industry Workshops jointly organized by Subtask A and the Task's Operating Agent have received a positive response from industry, especially from industry in the country just hosting the Experts' Meeting. Between 11 and 50 industry representatives attended the workshops.

LINKS WITH CEN TC 312

The possible work item for CEN on solar combisystems was discussed. Definition of such a work item means that:

- there is a clear document to work on;
- there is a prospect of having an EN or ENV (standard or draft standard) within 3 to 5 years;
- there should be sufficient support from industry.

For the DC test method, it was concluded that before bringing the work item to CEN the following is needed:

- more practical experience with DC testing;
- validation of the DC test method against CTSS;
- lobby with industry for support on solar combisystem testing.

After that, we are ready to present the work item to CEN. Estimated time is in autumn 2003. Still open is what the work item should contain, probably CTSS and DC but maybe more. Subtask B participants will prepare a presentation for the next CEN meeting in spring 2003.

REPORTS PUBLISHED IN 2002

Direct Solar Floor System Proceedings 6th International Symposium Gleisdorf SOLAR 2002
Letz, T.

Solare Kombianlagen im europäischen Vergleich, Proceedings 12th Symposium on Thermal Use of Solar Energy, Germany
Weiss, W.

Stagnation Behavior of Thermal Solar Systems Eurosun 2002 Conference, Italy
Hausner, R., Fink, C.

System Designs and Performance of Solar Combisystems
Hadorn, J.C., Weiss, W., Suter, J.M., Letz, T.

Thermal Store Testing – Evaluaton of Test Methods Thesis for licentiate exam. Chalmers University of Technology, Sweden, 2002
Bales, C.

Direct Characterization Test Procedure for Solar Combisystems (3rd and 4th draft) TNO Building and Construc-tion Research, 2002
Visser, H.

Kombinierte Solaranlagen zur Raumheizung und Warmwassererzeugung - Staffelstein 2002 Conference, Germany
Suter, J.-M. and H. Visser.

Vergleich von Kombianlagen, der Ansatz des IEA-SHC Task 26 "Solar Combisystems, Proceedings 12th Symposium on Thermal Use of Solar Energy, Germany.

Vergleich und Optimierung von solaren Kombisystemen, Proceedings 6th International Symposium Gleisdorf SOLAR 2002
Streicher, W.

Einfluss verschiedener Beladeeinrichtungen auf den Solarertrag eines typischen Kombisystems, Proceedings 6th International Symposium Gleisdorf SOLAR 2002
Jordan, U., Vajen, K.

REPORTS PLANNED FOR 2003

Third Industry Newsletter
The Industry Newsletters as well as the Task 26 Industry Workshop Proceedings are all available from the Task 26 homepage http://www.solenergi.dk/task26/downloads.html.

Technical reports

Subtask A

Validation and background information on the FSC procedure
Letz, T.

Stagnation behavior of collectors and systems
Hausner, R.

Detailed results on the architectural integration of collectors
Bergmann, I., Weiss, W.

One particular approach for the analysis of failure modes
Kovacs, P.

Changes noticed on the solar combisystem market since 1999 in the participating countries
Suter, J.-M.

Final Subtask report

Subtask B

Description of test facilities
Drück, H., R. Morlot, P. Kovács and P. Vogelsanger.

Description of the DC test method
Visser, H.

Hot water comfort testing, Drück, H.

Research into average meteorological conditions
Morlot, R.

Background of the DC test approach
Bales, C.

Investigation of the twelve days CCT approach
Vogelsanger, P.

Investigation of test conditions for the DC test method
Naron, D.

Experiences with CTSS and DC testing
Drück, H.

Experiences with real testing and comparison with operation in practice
Kovács, P.

Validation of CTSS testing by in situ measurements
Kerskes, H.

Development of a collector emulator
Perers, B.O.

Final Subtask report

Subtask C

Reference Conditions

Optimization Procedure

Non-standard TRNSYS-Models used in Task 26
Streicher, W.

Description and analysis of systems and its optimization including FSC-calculations and results (one technical report per system)

Comparison and analysis of the differences of systems

Elements of dream systems
Bony, J., Bales, C.

Material demand of systems
Streicher, W.

Final Subtask report

MEETINGS IN 2002

Seventh Experts Meeting
April 7 – 10, 2002
Oslo, Norway

Eighths Experts Meeting
September 22 – 25, 2002
Blumau, Austria

TASK 26 NATIONAL CONTACT PERSONS

Operating Agent
Werner Weiss
AEE INTEC
Arbeitsgemeinschaft ERNEUERBARE ENERGIE
Institute for Sustainable Technologies
Feldgasse 19
A-8200 Gleisdorf
Austria

Austria
Irene Bergmann and Robert Hausner
AEE INTEC
Arbeitsgemeinschaft ERNEUERBARE ENERGIE
Institute for Sustainable Technologies
Feldgasse 19
A-8200 Gleisdorf

Wolfgang Streicher and Richard Heimrath
Technical University of Graz
Institut für Wärmetechnik
Inffeldgasse 25
A-8010 Graz

Denmark
Simon Furbo, Louise Jivan Shah and Elsa Andersen
Solar Energy Center Denmark
Technical University of Denmark
Department of Buildings and Energy
Build. 118
DK-2800 Lyngby

Klaus Ellehauge and Line Louise Overgaard
Solar Energy Center Denmark
Teknologisk Institut
DK-8000 Aarhus C

Finland
Petri Konttinen
Helsinki University of Technology
Advanced Energy Systems
P.O. Box 2200
FIN-02015 HUT

France
Thomas Letz
ASDER
BP 45
299, rue du Granier
F-73230 Saint Alban-Leysse

Philippe Papillon
Clipsol-Recherche
Z.I.
F-73100 Trevignin

Rodolphe Morlot
CSTB
Energie, Environment Interieur et Automatisimes
Route des Lucioles
Boite postale 209
F-06904 Sophia Antipolis Cedex

Germany
Harald Drück and Henner Kerskes
Stuttgart University
ITW
Pfaffenwaldring 6
D-70550 Stuttgart

Klaus Vajen and Ulrike Jordan
Kassel University
Department of Mechanical Engineering
Solar and System Technology
D-34109 Kassel

The Netherlands
Huib Visser
TNO
Building and Construction Research
Division Building & Systems
P.O. Box 49
NL-2600 AA Delft
Visiting address:
Schoemakerstraat 97
NL-2628 VK Delft

Norway
Michaela Meir, Markus Peter and Bjørnar Sandnes
University of Oslo
Department of Physics
P.O.BOX 1048, Blindern
N-0316 Oslo

Sweden
Peter Kovacs
SP-Swedish National Testing & Research Institute
Box 857
S-501 Boras

Chris Bales and Klaus Lorenz
Högskolan Dalarna
Solar Energy Research Center - SERC
EKOS
S-78188 Bor(nge

Bengt Perers and Stefan Larsson
Vattenfall Utveckling AB
The Swedish National Power Board
P.O. Box 1046
S-61129 Nyköping

Switzerland
Jean-Christophe Hadorn
Swiss Research Program
CH-1035 Bournens

Jean-Marc Suter
Suter Consulting
Postfach 130
CH-3000 Bern 16

Ueli Frei, Peter Vogelsanger and Beat Menzi
SPF-HSR
Postfach 1475
CH-8640 Rapperswil

Philippe Dind, Olivier Renoult, Jacques Bony and Thierry Pittet
School of Engineering (EIVD)
Route de Cheseaux 1
CH-1400 YVERDON-LES-BAINS

United States
William A. Beckman
University of Wisconsin
Solar Energy Lab
1500 Engineering Drive
Madison, Wisconsin 53706

TASK 26 INDUSTRY PARTICIPANTS

Austria
Christian Holter
SOLID
Herrgottwiesgasse 188
A- 8055 Graz

Martin Bergmayr
Solarteam GmbH
Jörgmayrstraße 12
A-4111 Walding

Peter Prasser
Sonnenkraft GmbH
Resselstrasse 9
A-9065 Ebental

Denmark
Emanuel Brender
Batec A/S
Danmarksvej 8
DK 4681 Herfolge

Finland
Janne Jokinen
Fortum Advanced Energy Systems
P.O. Box 100
FIN-00048 Fortum

France
Philippe Papillon
Clipsol
Zone Industrielle
F-73100 Trevignin

Germany
Thomas Krause and Dagmar Jaehnig
SOLVIS- Solarsysteme GmbH
Marienberger Straße 1
D-38122 Braunschweig

Andreas Siegemund
Consolar Energiespeicher- und Regelungssysteme GmbH
Dreieichstrasse 48
D-60594 Frankfurt

The Netherlands
Erwin Janssen
ATAG Verwarming B.V.
P.O. Box 105
NL-7130 AC Lichtenvoorde

Edwin van den Tillaart
Daalderop B.V.
P.O. Box 7
NL-4000 AA Tiel

Paul Kratz
Zonne-Energie Nederland
De Run 5421
NL-5504 DG Veldhoven

Norway
John Rekstad
SolarNor AS
Erling Skjalgssons gate 19 B
N-0267 Oslo

Sweden
Bo Ronnkvist
Borö-Pannan AB
Bangardsuagen 1
S-95231 Kalix

Switzerland
M.C. Jobin
AGENA
Le Grand Pré
CH-1510 MOUDON

Fritz Schuppisser
SOLTOP Schuppisser AG
St. Gallerstrasse 7
CH-8353 ELGG

Josef Jenni
Jenni Energietechnik AG
Lochbachstrasse 22
CH-3414 Oberburg

TASK 27:

Performance of Solar Facade Components

Michael Köhl
Frauhofer Institute for Solar Energy Systems
Operating Agent for the Forschungszentrum Jülich

TASK DESCRIPTION

The objectives of this Task are to determine the solar visual and thermal performance of materials and components, such as advanced glazing, for use in more energy efficient, comfortable, sustainable buildings, on the basis of an application oriented energy performance assessment methodology; and to promote increased confidence in the use of these products by developing and applying appropriate methods for assessment of durability, reliability and environmental impact.

Scope

The work will focus on solar facade materials and components selected from the following:

- Coated glass products
- Edge sealed glazings, windows and solar façade elements
- Dynamic glazing (i.e., electrochromic, gasochromic and thermochromic devices, thermotropic and other dispersed media)
- Antireflective glazing
- Light diffusing glazing
- Vacuum glazing
- Transparent insulation materials
- Daylighting products
- Solar protection devices (e.g., blinds)
- PV windows
- Solar collector materials, including polymeric glazing, facade absorbers and reflectors

Means

The work in Task 27 is carried out in the framework of three subtasks.

- Subtask A: Performance (Lead Country: Netherlands)
- Subtask B: Durability (Lead Country: Sweden)
- Subtask C: Sustainability (Lead Country: France)

Main Deliverables

Subtask A: Performance

- A further developed coherent energy performance assessment methodology to enable comparison and selection of different products and to provide guidance for their assembly and integration into building envelope elements.
- A structured data base of components and façade elements to present data in a consistent and harmonised form, suitable for product comparison and selection and for simulation of performance in specific applications.
- Recommended calculation and test methods for solar and thermal performance parameters in support of international standards development.

Subtask B: Durability

- A validated methodology for durability assessment of advanced solar building materials.
- An estimation of the service lifetime based on degradation of performance for selected materials tested.
- Recommended standard test procedures for service life testing of selected materials and components.

Subtask C: Sustainability

- A review of international knowledge base, tools, actions and requirements related to glazing, windows and solar components.
- An overview of the FMEA tool capabilities, adaptation to the field

An electrochromic window developed by NREL in the United States.

of glazing, windows and solar components, and guidelines for using it in the assessment of possible shortening/reduction of the service life.

Duration

The Task was initiated in January 2000 and is planned for completion in December 2003.

ACTIVITIES DURING 2002

In general, a good progress was achieved on the main issues of performance, durability and sustainability.

Subtask A: Performance

- The extended report on performance indicators and terminology was completed. More emphasis was put on Fenestration Rating tools as a result of a respective workshop during the spring meeting.
- The energy performance assessment methodology for Subtasks A and B has been split into building and component performance indicators and drafted.
- Results of modelling the performance of buildings equipped with switchable glazing were compared.
- Work is in progress to define control strategies, monitoring and evaluation procedures.
- Links to other projects and organizations outside the Task have been established with the European projects SWIFT (switchable facade technology) and WINDAT (glazing and window database development). The outcome of the project and discussions may be useful for standards organisations. Links to CEN TC33 (Working Group on shading products) have been established as well.

Subtask B: Durability

- The general methodology for durability assessment has been completely defined and applied to various subjects.
- The adaptation of durability assessment methodology to specific chromogenic requirements has also been carried out. The accelerated ageing testing was started with some delays due to late supply of the test samples.
- Outdoor testing at ISE and CSTB is going on. Electrochromic samples were provided by Flabeg and gasochromic samples were distributed by Interpane.
- Candidate materials for durability and reliability assessment of static solar materials were identified and are investigated in the framework of the following case studies:
- Anti-reflective and polymeric glazing materials
- Reflectors
- Solar facade absorbers
- Initial risk analysis have been performed, samples have been exposed on outdoor test facilities at different locations and accelerated screening tests started for all case studies.

A gasochromic window developed by Fraunhofer ISE in Germany.

Subtask C: Sustainability

- A first attempt of data processing has been completed concerning the report about examples performed on reference products. The methodology report (nominal service life prediction and anticipation of premature termination), application to an example as well as the terminology report and the state of the art report were completed.

WORK PLANNED FOR 2003

Subtask A: Performance

- Final energy performance assessment methodology for Subtasks A and B (not achieved in 2001) for components and buildings.
- Definition of appropriate conditions for testing and calculation.
- Sensitivity studies report.
- Performance data report.
- Results of testing and modelling.

Subtask B: Durability

- General methodology for durability assessment validated by testing glazing materials and comparison with results of outdoor testing.

- Completion of first series of accelerated ageing testing of chromogenic glazings.
- Completion of second series of accelerated ageing tests for static solar materials.

Subtask C: Sustainability

- Reports of the Case Studies:
- Edge Sealed Glazing Units
- Breathing Units and TIM-Elements (not achieved in 2001)
- Final report of accelerated cyclic tests on "Edge Sealed Glazing Units" and "Assemble of Windows/Wall"

LINKS WITH INDUSTRY

Nine companies from five countries are participating in Task 27. Through these industry links, the participants of Task 27 can ensure the valuable use of its research results. See the list of Task 27 national contact persons for further details. The Japanese companies finished their participation because of general funding problems.

MEETINGS IN 2002

Fifth Experts Meeting
9-12 April
Copenhagen, Denmark
Included a joint meeting with SHC Task 31 and a "Window Rating" workshop.

Sixth Experts Meeting
30 September - 3 October
Ottawa, Canada
Included a workshop with Canadian colleagues and industry.

MEETINGS PLANNED FOR 2003

Seventh Experts Meeting
1-4 April
Lisbon, Portugal
Will include a workshop with local industry and research institutes.

Eighth Experts Meeting
13-17 October
Freiburg, Germany

TASK 27 NATIONAL CONTACT PERSONS

Operating Agent
Michael Köhl
Fraunhofer ISE
Heidenhofstr. 2
79110 Freiburg
Germany

Belgium
Magali Bodart
Université Catholique de Louvain
Architecture et Climat
Place du Levant 1
1348 Louvain-la-Neuve

Canada
Hakim Elmahdy
National Research Council of Canada
Institute Research in Construction
Montreal Road
M-24, Ottawa, Ontario K1A OR6

Denmark
Svend Svendsen
Technical University of Denmark
Department of Civil Engineering
Building 118
2800 Lyngby

Jan Fransson
VELUX A/S
Maskinvej 4
2860 Soborg

Finland
Ismo Heimonen
VTT Building and Transport
Building Physics and Indoor Climate
P.O. Box 1804
02044 VTT

France
Jean-Luc Chevalier
CSTB Centre Scientifique et Technique du Batiment
24, Rue Joseph-Fourier
38400 Saint-Martin d'Heres

Denis Covalet
EDF - Electricité de France Division
Recherche et Dévelopment
Site des Renardieres
77818 Moret-sur-Loing

Xavier Fanton
Saint-Gobain Recherche
B.P. 135
93303 Aubervilliers

Richard Mitanchey
ENTPE
Le Laboratoire des Sciences de l´Habitat
de l´Ecole des Travaux Publics de l´Etat
Vaulx-en-Velin

Germany
Michael Freinberger
ift. Rosenheim
Theodor-Gietl -Straße 7-9
83026 Rosenheim

Joachim Göttsche
FH Aachen
Solar-Institut Jülich
Abteilung Solares Bauen
Heinrich-Mussmann-Str. 5
52428 Juelich

Werner Platzer
Fraunhofer ISE
Heidenhofstr. 2
79110 Freiburg

Helen Rose Wilson
Interpane E & BmbH c/o Fraunhofer ISE
Heidenhofstr. 2
79110 Freiburg

Jens Cardinal
FLABEG GmbH & Co. KG
Glaserstr. 1
93437 Furth i. Wald

Italy
Maurizio Cellura
DEAF - Università di Palermo
Viale delle Scienze
Palermo
90128

Aldo Fanchiotti
Università degli Studi Roma Tre
Via della Vasca Navale 79
00146 Roma

Mario Tarantini
ENEA
Via Martiri di Montesole 4
40129 Bologna

Michele Zinzi
ENEA
Via Anguillarese 301
00060 S.Maria Di Galeria, Roma

Netherlands
Dick van Dijk
TNO Building and Construction Research
Department of Sustainable Energy and Buildings
P.O. Box 49
2600 AA Delft

Norway
Ida Bryn
Erichsen & Horgen A/S
P.O. Box 4464 Torshov
0403 Oslo

Portugal
Maria João Carvalho
Instituto de Technologias Energeticas (INETI)
Estrada do Paço do Lumiar 22
1649-038 Lisboa

Sweden
Bo Carlsson
SP Swedish National Testing and Research Institute
Materials Technology Section for Polymers
Box 857
50115 Boras

Björn Karlsson
Vattenfall Utveckling AB
Solar Energy
814 26 Älvkarleby

Arne Roos
University Uppsala
The Angstrom Laboratorium
Box 534
75121 Uppsala

Switzerland
Stefan Brunold
Institut für Solartechnik SPF
Hochschule Rapperswil HSR
Oberseestrasse 10
8640 Rapperswil

Hans Simmler
EMPA Eidgenössische
Materialprüfungs- und
Forschungsanstalt
Überlandstr. 129
8600 Dübendorf

USA
Dragan Curcija
University of Massachusetts
Center for Energy Efficiency and Renewable Energy
Engineering Lab Building
160 Govenors Dr.
Amherst, Massachusetts 01003-2210

James Fairman
Aspen Research Coorp.
1700 Buerkle Road
White Bear Lake, Minnesota 55110

Gary Jorgensen, Roland Pitts
NREL
National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, Colorado 80401-3393

Mike Rubin
Lawrence Berkeley National Laboratory University of California
MS 2 - 300
1 Cyclotron Road
Berkeley, California 94720

TASK 28 / BCS ANNEX 38:

Sustainable Solar Housing

S. Robert Hastings
Architecture, Energy and Environment GmbH
Operating Agent for the Swiss Federal Office of Energy

TASK DESCRIPTION

The goal of this Task is to help participating countries achieve significant market penetration of sustainable solar housing by the year 2010, by providing home builders, institutional real estate investors and banks with:

- A Task web site illustrating built projects, exemplary in design, living quality, low energy demand and environmental impact.
- Documentation sets of *Exemplary Sustainable Solar Housing* as a basis for local language publications to communicate the experience from built projects and motivate planers to develop marketable designs.
- A handbook: *Marketable Sustainable Solar Housing*: with guidelines, graphs and tables derived from building monitoring, lab testing and computer modeling.
- Demonstration buildings with press kits for articles and brochures in local languages to increase the multiplication effect beyond the local region.
- Workshops after the Task conclusion presenting the results of the Task.

Participation

Sharing the work of the Task this period are experts from 17 countries:

Austria	Japan
Australia	Netherlands
Belgium	New Zealand
Brazil	Norway
Canada	Sweden
Czech Republic	Switzerland
Finland	UK/Scotland
Germany	USA
Italy	

Duration

The Task was initiated in April 2000 and is planned for completion in April 2005.

ACTIVITIES DURING 2002

During the year 2002 several exciting developments occurred. To identify effective strategies for increasing market penetration of sustainable housing, marketing success stories were collected and are being analyzed and cross compared. Another interesting activity addressed the question: what are realistic performance targets for sustainable solar housing? To answer this, reference houses reflecting national building codes in twelve countries from three different climates were analyzed and compared to several currently popular low energy standards as well as to monitored pilot housing projects. Detailed data sets from such built projects have been compiled and analyzed in Subtask D, and complementary ecological life-cycle-analysis of selected projects is ongoing in the LCA working group.

Several positive changes occurred in 2002– A. Lien (Norway) accepted the lead of Subtask C and is coordinating the documentation of demonstration projects. R. Hyde (Australia) agreed to lead the work on sustainable housing in hot climates. Finally, the Task grew by experts from two new countries, New Zealand and the Czech Republic, which will host the next expert meeting.

Following is a summary of activities by Subtask and working groups.

Subtask A: Market-Assessment and Communication

A Task framework was used to analyze the housing markets in Austria, Canada, the Czech Republic, Finland, Japan, Norway, Netherlands and Switzerland and a useful picture is evolving. While it is common that energy is not a factor for most homebuyers, public awareness of environment issues is growing. An example is the marketing success of over 5,000 homes sold in the Netherlands, promoted with the WWF (Worldwide Wildlife) seal for sustainability. Making use of economical and innovative construction techniques have helped to cut costs of sustainable housing. Examples include the rapid introduction of:

- prefabricated, manufactured housing in Japan,
- panelized and modular housing construction in Scotland and the USA, and
- industrial, flexible and easily dismantled (IFD) constructions in the Netherlands.

To learn from experiences Task experts began analyzing and documenting sustainable housing "success stories." Two exceptional examples of increasing public awareness of the subject occurred on either side of the Atlantic. In front of the Capitals in Bern, Switzerland and Washington, DC, sustainable solar houses were erected to demonstrate this new generation of housing to the public. Thousands of visitors visited the exhibition houses and newspapers across the countries catapulted the subject into the national consciousness. The Task's Success Stories are due by the end of 2002 and will be compiled in a working document in 2003.

The Solar Decathlon held on the mall in Washington DC.
Source: R. Nahan, NREL

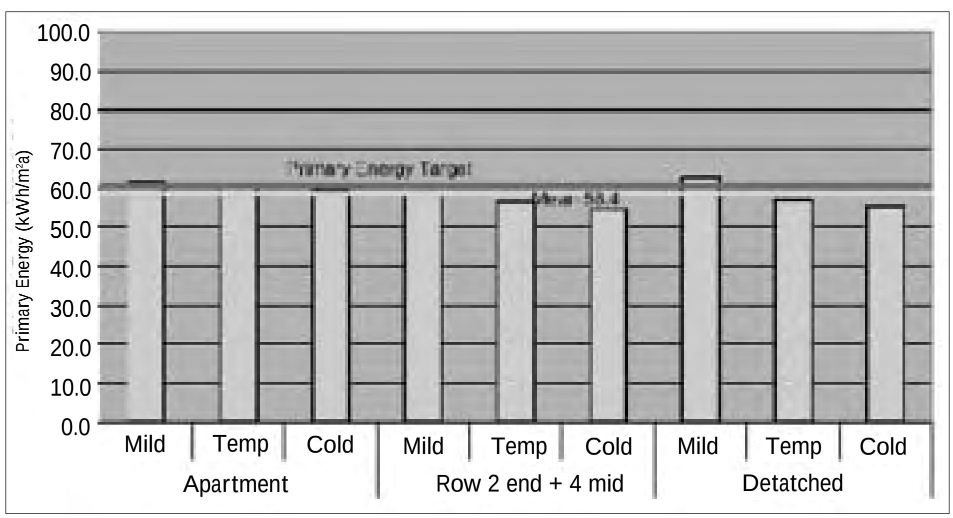

Figure 2. Primary energy supply target for the regional reference buildings, 60 kWh/m²a. (mean 58.4 is the light grey horizontal line)
Source: M. Wall (S)

The Renggli House constructed outside of the Swiss capital in Bern, Switzerland.
Source: Renggli AG

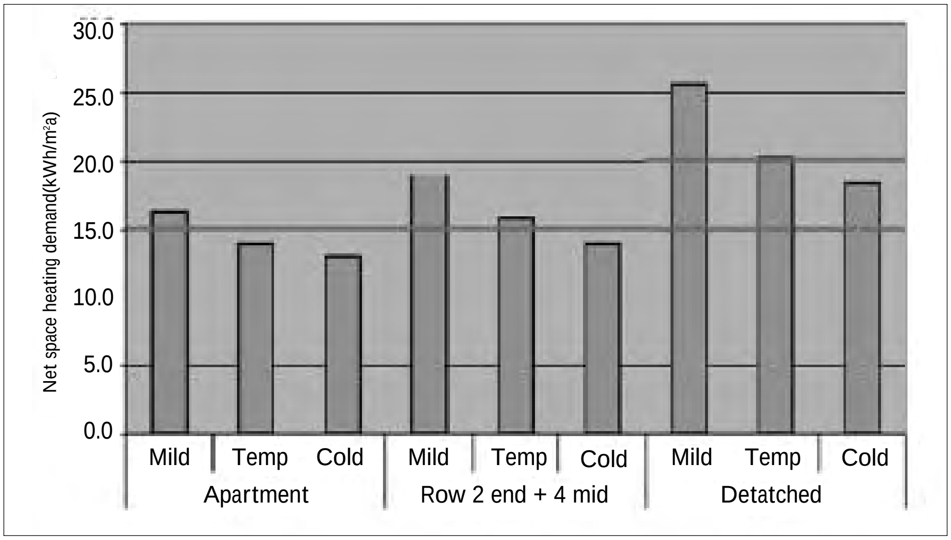

Figure 3. Heating demand targets for the regional reference buildings, (15 kWh /m²a for apartment and row housing, 20 kWh/m²a detached houses)
Source: M. Wall (S)

Subtask B: Design and Analysis
This Subtask is synthesizing results of the Task, together with analyses of design solutions to be presented in a handbook for planners. The main parts of the handbook are: basic principles, strategies, design solutions, and technologies. The two strategies being addressed are:

- Strategy I: Maximize energy conservation and heat recovery
- Strategy II: Maximize solar and renewable energy supply

Design solutions for each strategy have to be optimized against an energy target. To set the targets, twelve participating countries defined regional reference housing types that meet current building codes. Sweden then computed each building's energy consumption and applied reduction factors of 2, 3 and 4 as possible targets. These values were compared to Subtask D monitored data. For high performance housing of the future, a decision was made to use a factor four reduction for annual space heating and a factor two reduction for water heating, totaling 60 kWh/m² heated floor area. This figure is primary energy to put different heat production systems on an equal basis.

It is interesting to note that this target applied to the reference houses of northern and mild climates leads to the same value of 60. Tighter current building standards of the north offset the effect of the colder weather compared to mild climate regions. Also noteworthy, is that the electricity consumption for mechanical systems, when reported as primary energy, represents a substantial part of this target level. Based again, on Subtask D experience from built projects a figure of 5 kWh/m²a electricity is assumed, which when multiplied by 2.71 for primary energy, is nearly one quarter of the total target! To assure a minimum quality for the building envelope, a space heating target has been specified. Because of the higher A/V ratio of

Figure 4. Demonstration industrialized housing construction in Finland.
Source: J. Nieminen (FIN)

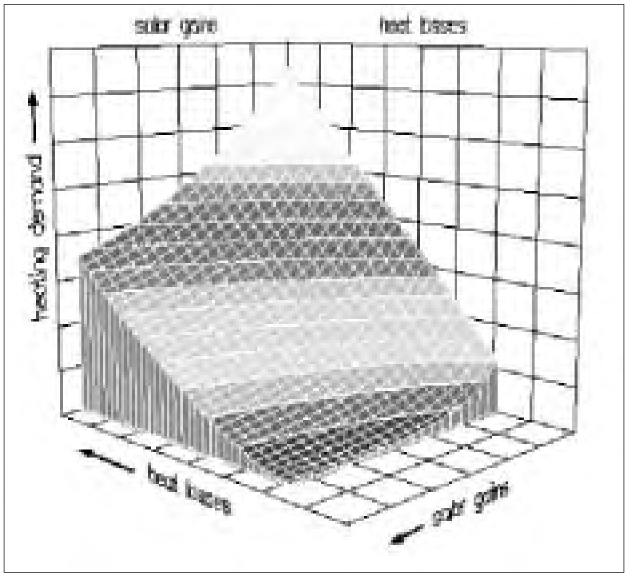

Figure 5a. Simulated correlation among solar gains, building heat losses and auxiliary heat demand.
Source: K.Voss

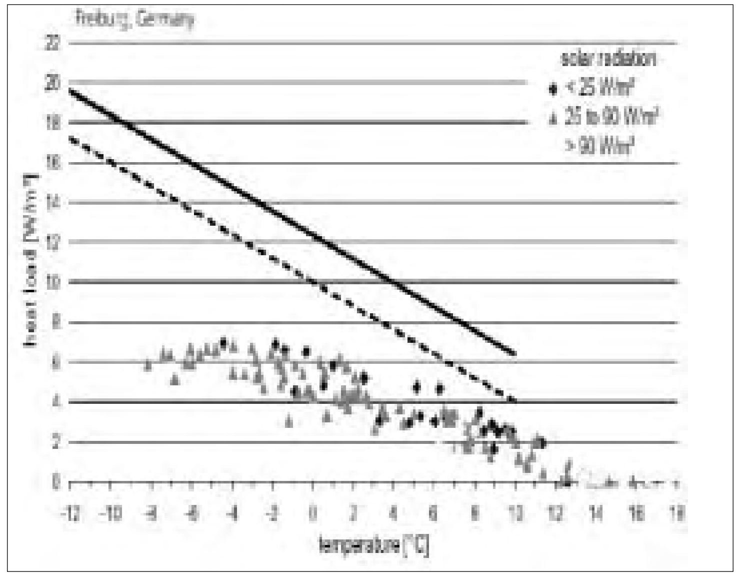

Figure 5b. Measured heating loads at different ambient temperatures and solar radiation levels
Source: K. Voss

detached housing, a higher space heating target for this type was deemed appropriate. Similarly, an increase in space heating target by 5 kWh/m²a for designs under Strategy II was considered acceptable, given that the increased losses have to be offset by renewable energy in order to meet the primary energy target of 60 kWh/m²a. This will permit designs making use of larger glazed areas, which otherwise would have to be compensated by unreasonably thick insulated walls to fulfill the loss targets. First design solutions were analyzed by Austria and Germany, using the dynamic programs DEROB and TRNSYS.

In parallel to the simulation work, drafts of 24 chapters on technologies used in the strategies were written and reviewed during expert meetings in 2002.

Subtask C: Demonstration

The purpose of Subtask C is to provide material to convince potential clients to build high performance housing. For this purpose the Task is preparing brochures presenting convincing demonstration projects. The first brochures were prepared by Norway and Switzerland. The brochures are intended as raw material for articles in national professional journals to increase awareness of innovative sustainable solar housing designs.

Subtask D: Monitoring and Evaluation

Forty-two projects have been reported using the Task standardized project characterization formats. These data sets are a valuable source for learning what measures have proven effective (or not). One key factor in high performance housing is the usability of solar and internal gains to offset auxiliary heating. The interdependencies of usability are illustrated in Figure 4 by the computer generated slopes of the heat demand curves with changing solar gains at various levels of building heat losses. Almost 100% of the gains are utilized in a house with high losses and small solar gains, whereas in the case of extremely low heat losses increased solar gains only minimally reduce auxiliary heat demand. Monitored data from the Freiburg apartment building are graphed in Figure 5. The solid line represents the theoretical case of zero solar and internal gains, the dashed line assumes constant internal gain of 2.1 W/m² with 100% usability. The scatter of measured data points indicates the dependency of heating demand on ambient temperature and solar intensity. It can be seen that as the solar radiation increases from <25, to 25-90 to >90 W/m² the heating demand drastically decreases and flattens. Wide variations in the usable passive solar contribution can be observed among the collected monitoring projects. This analyses parallels sensitivity studies of solutions now underway by computer modeling.

LCA Working Group

To address non-energy aspects of sustainability in high performance housing a working group is projecting the ecological impacts of selected projects over their life span. For this purpose Switzerland is using two tools ÖGIP and, as a check, a self-written Excel based program: EcoCheck. Germany is using KEA, an analysis of the Cumulative Energy Effort". Finally, Belgium is using a new, holistic analytical approach developed during the Task. These diverse analytical approaches allow different optics for viewing the problem of ecological assessment. In 2002, three projects from Subtask D were analyzed: Sunny Woods and Nebikon in Switzerland and Gelsenkirchen in Germany. Additional exemplary buildings will be analyzed in 2003. The projects selected represent a good mix of quality design solutions.

Hot Climates Working Group

This working group is examining designs for sustainable housing in cooling dominated climates. Design principles are being drawn from the experience from built projects. An exciting range of projects have been selected, including: passive cooled houses in Australia, pilot low income houses in Brazil, an urban housing typology in Rome, indigenous house forms in Indonesia and innovative technical solutions in Japan. Two important aspects being addressed for low income housing are: providing comfort without compression air conditioning and using solar energy to economically produce hot water. The Group uses its own web site to coordinate the work: http://csdesign.epsa.uq.edu.au/index.php?dir=517.

WORK PLANNED FOR 2003

Subtask A: Task Communication and Market Analysis

Successes in marketing sustainable housing will be analyzed and documented by the experts. The structured 2-4 page mini-chapters submitted at the end of 2002 will be collectively analyzed and frequently repeating strategies and tactics identified. The resulting working document is scheduled for completion by the end of 2003 and will provide input to the Subtask B handbook.

Subtask B: Design and Analysis

Design Guide. All of the Technology Chapters for the Handbook will be written, distributed via the working web site and reviewed at the April Expert meeting. This part of the handbook should be completed by the end of the 2003.

Supporting Analysis for the Handbook. Design solutions for the two strategies will be optimized. Work completed in 2002 by: S. Larsen (A) will be complemented in 2003 by simulations carried out by: G. Fanninger (A), J. Morhenne (D), U. Gieseler (D), M. Wall / J. Smeds /T.Boström (S), T. Dokka (N) and L. Gattoni (I). Initial results and underlying assumptions will be reviewed at a working meeting on 26-27 January 2003 in Siegen (D) hosted by F. Heidt. The simulation work should be completed in the year 2003, with final evaluation and graphical presentation of results ready for the handbook by 2004.

Subtask C: Demonstration

Additional demonstration projects will be documented in Task 28/38 brochures. These can be "published" as PDF-files on the IEA SHC T28 internet site.

Subtask D: Monitoring & Testing

Missing information for the building documentation sets will be submitted by the deadline of the spring 2003 expert meeting. This will close out this data collection effort. Experts will continue to supply summary data from monitored projects as a resource for extracting rules of thumb for the handbook.

LCA Working Group

In 2003 additional Subtask D housing projects will be analyzed and results, as well as a description of the methodology prepared for inclusion in the handbook. The work will be checked at a working meeting planned in Cologne on 28 January 2003.

Hot Climates Working Group

First drafts of the Guidelines and Examples will be prepared in 2003. The autumn expert meeting will take place in a subtropical part of Australia and include a technical tour to visit housing with innovative / indigenous cooling concepts.

LINKS WITH INDUSTRY

Many Task experts represent specific industries, i.e. the Norwegian State

Housing Bank, ABB, Swiss and Canadian construction firms and others.

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MEETINGS IN 2002

5th Expert Meeting
April 17-19
Rome, Italy

6th Expert Meeting
September 18-20
Goteborg, Sweden
Subtask D Working Meeting
October 10-12
Freiburg, Germany

MEETINGS PLANNED FOR 2003

Subtask B Analyses Group
January 26-27
Siegen, Germany

LCA Working Group
January 28
Cologne, Germany

7th Experts Meeting
April 7-9
Prague, Czech Republic

8th Experts Meeting
November 4-7
Australia

SHC TASK 28/ECBCS ANNEX 38
NATIONAL CONTACT PERSONS

Operating Agent
Robert Hastings
(Subtask B Co-Leader)
Architektur, Energie & Umwelt GmbH
Kirchstrasse 1
CH-8304 Wallisellen, Switzerland
+41 1 883 17 17
robert.hastings@aeu.ch

Austria
Gerhard Faninger
IFF
University of Klagenfurt
Sterneckstrasse 15
A-9020 Klagenfurt
+43 463 2700 6125
gerhard.faninger@uni-klu.ac.at

Australia
Richard Hyde
(Hot Climates Working Group Leader)
Department of Architecture
The University of Queensland
St. Lucia
AUS-4072 Brisbane
+61 7 336 538 78
r.hyde@mailbox.uq.edu.au

Belgium
Andre DeHerde
Architecture et Climat
Univ. Catholique de Louvain
Place du Levant 1
B-1348 Louvain-la-Neuve
+32 10 47 23 34
demyttenaere@arch.ucl.ac.be

Brazil
Marcia Ribeiro
Fed. Univ. of Minas Gerais
Rua Inconfidentes 355/J001
BR-Belo Horizonte, MG CEP-30140-120
+55 31 3221-2118
marciaag@uai.com.br

Canada
Pat Cusack
Arise Technologies Corp.
321 Shoemaker St.
CDN-Kitchener, Ontario, N2E 3B3
01 519 725 22 44
pat.cusack @ arisetech.com

Czech Republic
Miroslav Safarik
@ZECM Envir. Institute
Kodanska 10
CR-10010 Praha 10
+42 0 2 672 25 205
safarik@ceu.cz

Germany
Karsten Voss
(Subtask D Leader)
Fraunhofer ISE
Inst. for Solar Energy System
Heidenhofstr. 2
D-79110 Freiburg
+49 761 4588 5135
kavoss@ise.fhg.de

Finland
Jyri Nieminen
VTT Building & Transport
Building Physics
P.O. Box 1803
FIN-02044 VTT
+358 9 456 49 22
jyri.nieminen@vtt.fi

Italy
Francesca Sartogo
PRAU
Via Costabella, 34/36
I-00197 Roma
+39 06 454 20 463
prau@fastwebnet.it

Japan
Motoya Hayashi
Miyagigakuin Womens' College
9-1-1 Sakuragacka Aobaku
J-981-8557 Sendai
mhns01234@@aol.com

Norway
Anne Gunnarshaug Lien
(Subtask C Leader)
Enova SF
Innherredsv. 7A
N-7014 Trondheim
+47 73 84 57 68
anne.g.lien@enova.no

Netherlands
Peter Erdtsieck
(Subtask A Leader)
MoBius consult bv.
Diederichslaan 2
NL-3971 PC Driebergen - Rijsenburg
+31 343 51 28 86
peter@mobiusconsult.nl

New Zealand
Albrecht Stoecklein
Building Research Assoc.
Private Bag 50908
NZ-Porirua
+64 4 238 13 83
albrechtstoecklein@branz.co.nz

Sweden
Maria Wall
(Subtask B Co-Leader)
Dept.of Constr.& Arch.
Lund University
P.O. Box 118
SE-221 00 Lund
+46 46 222 96 62
maria.wall@ebd.lth.se

Scotland
Gökay Deveci
Faculty of Design & Technology
Robert Gordon University
Garthdee Rd.
UK-Aberdeen, Scotland
+44 1224 263714
g.deveci @ rgu.ac.uk

USA
Guy Holt
Coldwell Banker
6317 NE Antioch Rd.
USA-64119 Kansas City MO
+1 816 587 5800
guyhold@coldwellbanker.com

TASK 29:

Solar Crop Drying

Doug Lorriman
Namirrol Ltd.
Operating Agent for Natural Resources Canada

TASK DESCRIPTION

One of the most promising applications for active solar heating worldwide is the drying of agricultural products. In a recent study, the potential amount of energy that could be displaced using solar in this market was estimated to be between 300 PJ and 900 PJ annually, primarily in displacing fuel-fired dryers for crops that are dried at temperatures less than 50(C.The use of solar energy for these markets is largely undeveloped. Wood and conventional fossil fuels are used extensively at present. In many countries, more expensive diesel and propane fuels are replacing wood. Three key barriers to increased use of solar crop drying are the lack of awareness of the cost-effectiveness of solar drying systems, the lack of good technical information and the lack of good local practical experience.

The objective of the Task is to address the three barriers above by providing technical and commercial information and experience gained from the design, construction and operation of full-scale, commercially viable solar drying systems for a variety of crops and a number of geographical regions where solar is expected to have the greatest potential. Crop grower and processor industry associations will be key partners in dissemination of the results.

Duration

The Task was initiated in January 2000 and is planned for completion in June 2004.

ACTIVITIES DURING 2002

Panama – Coffee Drying

The solar installation on a new coffee processing plant near Sona, Panama, was completed earlier in the year and has awaited the coffee harvest to commence in December before operational results can be obtained. The installation actually involves two systems, one to preheat air, which is fed to the primary vertical dryers, and the other preheats air for silos that store the dried beans. Preliminary testing of the solar system and the monitoring system has been successfully completed and a Task participant will be going to Panama to commission the system for operation.

Late in the year, the owner of the processing plant indicated an interest in a second facility that would be designed to use dry chaff and solar energy as the only heat sources.

Solar drying facility for chicken manure in New York State, USA

India – Coir Pith Drying

The system to preheat air for drying coir pith was successfully installed during the year and is now fully operational. It is expected that the monitoring system will be installed early in 2003 and full monitoring will start shortly thereafter. The owner of the system is pleased with the preliminary performance of the solar system and has indicated an interest in installing a second solar system at his facility. Coir Pith is a powder found on the shells of coconuts, which after processing, is widely used as a fertilizer.

India – Cardamon Drying

A project in India to use solar energy to dry the spice Cardamom has been on-again, off-again throughout the year. Happily, late in the year, the owners of the facility have agreed to proceed with the project and installation is planned for early 2003.

China – Biomass Drying

This project in Lianghe, China, is proposed for a facility where fuel briquettes are manufactured by combining coal and straw. Initially, the project did not involve mechanical drying, however, the owners are now intending to include a drying chamber and boiler. Input from Task 29 has included both the design and installation of the solar air heating system and the design of the mechanical drying system. Design documents have been exchanged a number of times through the year. A delegation of key Chinese officials involved in this project visited Canada in December to finalize matters. An additional purpose of the visit was to explore the possibility of establishing a business in China to manufacture and market the Solarwall® panels which will be used on the project.

Task 29 experts examining solar collector on coffee drying facility near Sona, Panama.

China – Jujube Drying

The project started the year positively. Progress was achieved in the construction of a small demonstration unit, which is now operating. Progress was also achieved in the construction of the main larger facility building. The walls of the building have been completed. The scope of the project has been expanded to include the design of a new dryer to replace an older traditional but inefficient design which is currently used. The design of the new dryer has been completed. Later in the year, the project unfortunately encountered some financial difficulties and further work is on hold until further financing can be arranged.

Zimbabwe – Tobacco Drying

Non-technical matters have hampered work on the Zimbabwean project. The Task participant, ZEN, has decided not to proceed with activities in Zimbabwe because of the uncertain political and economic climate. They do not currently have the capacity to explore initiatives in other countries. Negotiations are underway to continue the Dutch participation in the Task through different means.

Costa Rica – Coffee Drying

In conjunction with the Task meeting held in San Jose early in the year, Task participants visited three coffee drying facilities, which were candidates for the addition of a solar heating system. From these, one site was selected and a feasibility study was completed. A proposal was made to install a solar system at the selected site and near the end of the year and positive response was received from the owners. It is expected that

Solar tobacco drying installation at Tobacco Research Station, Zimbabwe.

the solar system will be installed early in 2003.

United States – Various Projects
Project progress in the United States has exceeded our expectations. Two systems have been installed in California, one for drying prunes and the other for drying walnuts. Both are now operational and although they are still undergoing some adjustments, appear to be operating satisfactorily. The economic feasibility of the prune drying application is still uncertain due to the short 3-week drying period but the walnut drying appears to be an excellent application and two more installations are being considered in the near future.

Also in the United States, two projects have been completed in New York State and one other is expected to be completed in the next month. A system to dry chicken manure and another to dry wool are both year round operations which represent the optimum economics for solar drying. The third system will be used to dry grain, which is only a seasonal application, but the system will also be used to provide heat to a workspace on the farm, which significantly improves the economic case.

At the present time, there is no intention to do detailed monitoring on the US projects but basic performance information will be obtained and reported on.

ACTIVITIES PLANNED FOR 2003
The following activities are expected to be completed in 2003:

Project	Status
Panama – Coffee Drying	System monitored
India – Coir Pith Drying	System monitored
India – Cardamon Drying	Solar system installed System monitored
China – Jujube Drying	Facility construction completed System commissioned Monitoring installed
China – Biomass Drying	Facility completed Solar system installed System monitored
Zimbabwe – Tobacco Drying	System report completed
Costa Rica – Coffee Drying	System design completed System installed Monitoring installed
USA – Prune Drying	Operational results reported
USA – Walnut Drying	Operational results reported
USA – Chicken Manure Drying	Operational results reported
USA – Wool Drying	Operational results reported
USA – Grain Drying	System installed Operational results reported

LINKS WITH INDUSTRY
The Task continues to maintain excellent links with industry as summarized below:

- The owners of the Panamanian coffee processing plant have indicated an interest in building a second facility which will use only dry chaff and solar as the energy sources. If this is successful, it could show the way for other coffee producers in the area to reduce or eliminate their dependence on wood or fossil energy fuels.

- The completion of the system in Costa Rica should further demonstrate the feasibility for using solar crop drying systems in the region. This project and the Panamanian project should serve as a step to broader commercial adoption in Latin America in general and specifically in Central America. A local representative has assisted in the Task projects and has expressed an interest in becoming more involved in the commercialization process. Initial discussions have been held and more are expected.
- The owners of the briquette factory in China have expressed an interest in the manufacture and marketing of Solarwall® products in that country. This decision will follow the assessment of the performance of the Task 29 system being installed on their plant.
- The projects in India have further helped the local Solarwall® distributor to develop local crop drying markets. They have also developed other products that improve the performance of the solar system and the efficiency of the drying process for some crops.
- One of the projects in the USA was an indirect result of a meeting with Task 29 participants to discuss ways to improve the efficiency of the Chinese jujube project.

REPORTS PUBLISHED IN 2002

No official reports were published in 2002.

REPORTS PLANNED FOR 2003

The Task plans to publish another newsletter in 2003 to provide updated information on the active projects.

MEETINGS IN 2002

Fourth Experts Meeting
Feb 25 - 27
San Jose, Costa Rica

MEETINGS PLANNED FOR 2003

The meetings have yet to be confirmed. Plans are as follows:

Fifth Experts Meeting
February/March
India

Sixth Experts Meeting
October/November
China

TASK 29 NATIONAL CONTACT PERSONS

Operating Agent
Doug Lorriman
Namirrol Ltd.
38 Morden Neilson Way
Georgetown, ON
Canada L7G 5Y8

Canada
Doug McClenahan
Alternative Energy Division
CANMET
Natural Resources Canada
580 Booth St.
Ottawa, ON
Canada K1A 0E4

John Hollick
Conserval Engineering Ltd.
200 Wildcat Road
Downsview, ON
Canada M3J 2N5

Netherlands
Paul Kratz
Zen Solar
De Run 5421
5504 DG Veldhoven

United States
Peter Lowenthal
Solar Energy Industries Association
4733 Bethesda Avenue, Suite 608
Bethesda, Maryland 20814

TASK 31:

Daylighting Buildings in the 21st Century

Nancy Ruck
University of Sydney
Operating Agent for the Australian Master Builders Association

TASK DESCRIPTION

Task 31 seeks to make daylighting the typical and preferred design solution for lighting buildings in the 21st century. The intent is to integrate human response with the application of daylighting systems and shading and electric light control strategies. And finally, to ensure the transfer of the Task's results to building design professionals, building owners, and manufacturers.

The Task is focusing on commercial buildings, both new and existing, including office, retail, and institutional buildings such as schools. Fourteen countries and 24 institutions in Europe, North America, Asia, Australia and New Zealand are now collaborating in the work. To carry out this work there are four main Subtasks each with 4-5 project areas.

- Subtask A: User Perspectives and Requirements
  (Lead Country: Canada)
- Subtask B: Integration and Optimisation of Daylighting Systems
  (Lead Country USA)
- Subtask C: Daylighting Design Tools
  (Lead Country: Germany)
- Subtask D: Daylight Performance Tracking Network and Design Support
  (Lead Country: France)

Duration

The Task 31 was initiated in September 2001and will be completed in September 2005.

ACTIVITIES DURING 2002

A Task 31 brochure was published in September 2002 and is available by contacting the Operating Agent, Dr. N.C. Ruck.

Subtask Activities

Subtask A: User Perspectives and Requirements

The members of Subtask A have investigated current knowledge on human response to the application of daylighting systems and control strategies. The development of a database of important literature on the topic has commenced and so far 30 entries have been submitted. Brainstorming sessions on each topic in the database are to be initiated in future experts meetings. The hypotheses that have been established to assist in the monitoring of field studies, have identified areas of mutual interest, for example, visual comfort and evaluation indices, user operation of shading devices and electric lighting, energy performance related to shading devices and controls. This is to enable results from field and laboratory studies to be compared and ultimately placed in a unified context.

The following field studies are being undertaken:

- ISE New Building in Freiburg, Germany (Sebastian Herkel, Germany)
- LESO Building in Lausanne, Switzerland (Nicolas Morel, Switzerland)
- SWIFT user assessment studies of switchable glazings (Ariadne Tenner, The Netherlands)
- ENTPE field studies in Lyon, France (Marc Fontoynont, France)

As it has been difficult to identify a

The National Gallery of Canada in Ottawa.

standard measurement procedure for all the field studies, a common format on the presentation of results is being adopted.

Subtask B: Integration and Optimisation of Daylighting Systems
In Subtask B a simple web site has been set up to accommodate the internal operations of the Subtask. It is limited to Subtask B participants for now, but will contain some password-protected sections in the future. In a State-of-the-Art review, comparisons of data contributions from different countries have revealed significant differences between the US and Canadian markets and those in the Netherlands and Belgium. For example, data from the Netherlands suggest that 35% of new office buildings use daylighting controls whereas the number in the US is below 5%. It is evident that understanding the technology and market differences that lead to these end results will be important in our efforts to make daylighting the preferred design solution in buildings.

A preliminary design solutions roadmap has been drafted. The concept for this roadmap is that owners and members of a design team often lack a clear set of performance goals in designing a daylighted building and further do not often understand the options limits, tools and pathways that lead to a successful achievement of those goals. The roadmap will provide assistance throughout the design process from schematic design to working drawings. A process or tool for the early design stage is to be set up to help display the effects of changing certain parameters.

Preliminary drafts of working documents on guidelines for the design of control systems and for commissioning and calibrating control systems have been prepared. The major challenge is to minimize the need for complex approaches to calibration and commissioning. This work is being closely coordinated with the work of Subtask A in order to address user needs as well as energy savings. Test sites have been identified for field studies in Australia, Finland, Sweden, Switzerland, Italy, Canada and the Netherlands. The daylighting systems to be used in these field tests include a wide variety ranging from electrochromic windows to roof heliostats. A test room protocol for performance is to be based on IEA SHC Task 21 procedures and will be modified as required

Subtask C: Daylighting Design Tools
A questionnaire on user expectations of design tools was developed and distributed at the Fraunhofer Daylight Exhibition Stand in the Light and Building Fair in Frankfurt in April 2002. It is also to be distributed to software users in the different countries.

Sky models are being applied to the RADIANCE lighting simulation Work is continuing on a numerical photogoniometer based on the commercial forward raytracer OptiCad. Minor corrections in the virtual test set-up have been performed. Validation work comparing computed transmittance and BTDFS for standard glazing, prismatic elements and lasercut panels have been performed. Performance measures for the numerical photogoniometer have been evaluated

A provisional list of tools has been identified to be used in a tools catalogue. The selection criteria on what tools are to be used at which design stage is being set up by the Netherlands. Rather than developing a separate design document LBNL is to implement a prototype www site for the tools catalogue.

Validation results are to be made available to the CIE (Commission Internationale de L'Eclairage). Up to 10 institutions (IEA and CIE working group) have agreed to perform validation runs for more than 10 lighting calculation engines for simple cases. For more complex fenestration systems, it has been agreed to work on a data set based on a seraglaze sample.

Subtask D: Performance Tracking Network and Design Support Groups

A Task web site with Subtask pages can be reached from www.iea-shc.org/task 31. For the Subtasks, the address is www.iea-shc.org/task 31/subtask_a (or subtask_b, subtask_c and subtask _d). A password is required for the private section and can be obtained by contacting Michael Donn.

At this time, 30 entries have been submitted to a literature database. The Technical University in Berlin (TUB) has two databases: literature, and daylighting systems and control systems. The literature database contains 500 papers and all relevant papers are to be included in the Task's database. The following material has been proposed for support groups: pdf files of publications and reports, pdf files of PowerPoint presentations, pictures and graphs of exemplary buildings, pictures and graphs of site visits, pictures and graphs of measurements.

Technical Visits

At the second Experts Meeting in Roskilde, Denmark in April 2002, visits were made to the Danish Design Centre and RealDanmark Foundation building (Architect Henning Larsen). A technical visit also was made to the National Gallery of Canada during the third Experts Meeting in Ottawa in September/October 2002. At the National Gallery a standard gallery space was monitored for illuminances and an aural questionnaire on the lighting carried out with participants. The results will be added to the Task's web site database.

A test room in Oakland, California, USA that is showing electrochromic glass.

Joint Workshop

A joint workshop with IEA SHC Task 27 was held on April 10, 2002 in Copenhagen, Denmark. Presentations given included ones on REVISCOM, DYASIM, a state-of-the-art review of visual comfort, visual comfort and glare control criteria in the case of daylighting systems, the development of an adapted control system as a link between SHC Tasks 27 and 31, and basic criteria to satisfy industry needs. Future activities in terms of cooperation between SHC Tasks 27 and 31 were introduced regarding comfort/discomfort criteria and user behaviour and software. The following persons were appointed to ensure liaisons between the two SHC Tasks. For Task 31 they are Christoph Reinhart (Subtask A), Steve Selkowitz, (Subtask B), Hans Erhorn, (Subtask C), and Marc Fontoynont (Subtask D).

Joint Mini-Conference with CIE Division 3: Interior Environment and Lighting Design

A very successful joint mini-conference was held with Division 3 of the Commission Internationale de L'Eclairage during the Ottawa meeting. There were several interesting papers presented including papers on occupant preferences in offices with respect to electric lighting and

A Test room at EPFL in Lausanne Switzerland that is showing an anidolic device.

use of glare control techniques, genetic algorithms with images to evolve lighting preferences, benchmarks to evaluate lighting computer programs and a CIE-UK project on future lighting research areas.

WORK PLANNED FOR 2003

The following work is planned for the different subtasks

Subtask A

- Information in literature database to be summarized when more entries are received and a discussion within Subtask A on one of the database topics to be initiated.
- A paper on glare indices to be drafted.
- A series of reports on the individual field studies will be presented.
- The application of assessment methods is to be continued.
- A publication on a manual lighting control model.

Subtask B

- Benchmarks for the performance of conventional buildings to be determined from a number of countries so that benefits from daylighted buildings can be claimed.
- Performance targets that will serve as goals for the design process to be considered.
- A generic roadmap for the design process to be further developed.
- Further case studies to be examined as reality checks on the road map format
- A tool will be set up (preferably by adapting an existing tool) to display the effects of changing specific parameters.
- Exploration will commence on improved control systems and a more detailed R & D plan developed.
- A master list of projects developed with Subtask A in which either human factors or controls or both will be studied.
- Data display and visualization formats will be determined for reporting test results.
- A test protocol for field studies will be determined by modifying IEA Task 21 monitoring procedures.
- A multi-year test plan for test rooms and buildings will be drafted.

Subtask C

- A telephone conference is to be held in February.
- A roadmap towards an ADELINE 4.0 to be prepared and presented at the next experts meeting
- The application of an "all sky model" into the RADIANCE simulation will be documented. To provide different simulation engines with a variety of sky models it is intended to provide a sky model plug-in.
- A set of performance criteria of numerical and real photogoniometers is to be defined.
- Prototype www site will be implemented for the tools catalogue.
- Validation runs on 10 simple cases to test diverse software tools.
- For more complex cases datasets are to be based on a seraglaze sample.

Subtask D

- Relevant papers from the TUB web site are to be included in Task's web site.
- Noteworthy buildings are to be included in the database, including the National Gallery of Ottawa.
- PowerPoint presentations are to be created for the different professions and industries.
- The infrastructure of country/regional support groups to be set up.

LINKS WITH INDUSTRY

Industries that have participated in Task 31 Experts Meetings or supported the Task in the following countries are:

- Australia: Skylights Industry Association Inc. Queensland Government: Department of the Built Environment
- Belgium: St. Gobain Glass
- France: HEXCEL Fabrics, TECHNAL and INGELUX
- Germany: LichtVision
- Netherlands: Philips Lighting B.V.; Etaplighting B.V.
- United States: AAMA, WDMA, PGMA, AIA, IESNA and Energy Center, Wisconsin

REPORTS PUBLISHED IN 2002

Two issues of the International Daylighting R D & A were published.

REPORTS PLANNED FOR 2003

Report on field studies

Report on manual lighting control model

Document on roadmap

Document on data display and visualization formats for reporting test results

Document on test protocol for field studies

Document on test plan for test rooms and buildings

Survey Questionnaire

Draft working document on plug-in interface specification

Numerical photogoniometer performance rating specification

PowerPoint presentations for architects and industry

Reports on noteworthy buildings for database

MEETINGS IN 2002

Second Experts Meeting
April 8-11
Roskilde, Denmark

Third Experts Meeting
September 30-October 5
Ottawa Canada

MEETINGS PLANNED FOR 2003

Fourth Experts Meeting
April 14-17
Wellington, New Zealand

Fifth Experts Meeting
Date to be determined
Lausanne, Switzerland

IEA SHC TASK 31 NATIONAL CONTACT PERSONS

Operating Agent
Nancy Ruck
University of Sydney
Sydney NSW 2006
Australia
E-mail: ncr1@ozemail.com.au

Australia
Stephen Coyne and Phillip Greenup
Centre for Medical, Health
Environment Physics
School of Physics & Chemical Sciences
Queensland University of Technology
GPO Box 2434
Brisbane, 4001
E-mail: s.coyne@qut.edu.au
E-mail: p.greenup@qut.edu.au

Marc Luther
Built Environment Research Group
Deakin University
Geelong, Victoria
E-mail: luther@deakin.edu.au

Belgium
Magali Bodart
Université Catholique de Louvain
Architecture et Climat
Place de Levant 1
1348 Louvain-la-Neuve
E-mail: bodart@arch.ucl.ac.be

Canada
Guy Newsham
National Research Council
Indoor Environment Research Program
1500 Chemin Montreal Road (M-24)
Ottawa, Ontario K1A OR6
E-mail: guy.Newsham@nrc.ca

Christophe Reinhart
National Research Council,
Canada Institute for Research in Construction
1500 Chemin Montreal Road
Ottawa, Ontario KIA OR6
E-mail: christoph.reinhart@nrc.ca

Denmark
Kjeld Johnsen
Danish Building and Urban Research
Energy and Indoor Climate Division
Postboks 119
DK-2970 Hørsholm
E-mail: kjj@by-og-byg.dk

Finland
Liisa Halonen
Helsinki University of Technology
Otakaari 5 A
02150 Espoo
E-mail: liisa.halonen@hut.fi

Jorma Lethovaara
Helsinki University of Technology
Lighting Laboratory
PO Box 3000
FIN-02015 HUT
E-mail: jorma.lehtovaara@hut.fi

France
Marc Fontoynont, Fawaz Maamari, and Yannick Sutter
ENTPE/DGCB
Rue Maurice Audin
69518 Vaulx-en-Velin, Cedex
E-mail: marc.fontoynont@entpe.fr
E-mail: maamari@entpe.fr
E-mail: sutter@entpe.fr

Laurent Escaffre and Christophe Marty
Ingelux
E-mail: escaffre.ingelux@espace-arco.com
E-mail: marty.ingelux@espace-carco.com

Germany
Jan de Boer and Hans Erhorn
Fraunhofer-Institut für Bauphysik
Nobelstrasse 12
70569 Stuttgart
E-mail: jdb@ibp.fhg.de
E-mail: erh@ibp.fhg.de

Italy
Valentina Serra
Politecnico di Torino
10125 Torino
E-mail: serra@archi.polito.it
Anna Pedllegrino
Dipartimento di Energetica-
Facolta di Architettura-
Politecnico di Torino
Viale Mattioli 39
10125 Torino
E-mail: pellegrino@archi.polito.it

Japan
Koga, Yasuko
LASHE-ENTPE
Rue Maurice-Audin
69518 Vaulx-en Velin Cedex
E-mail: yskktar@mbox.nc.kyushu-u.ac.jp

Netherlands
Laurens Zonneveldt
TNO-TUE
Centre for Building Research
P.O. Box 513
5600 MB Eindhoven
E-mail: l.zonneveldt@tue.nl

Myriam Aries
Eindhoven Technical Univeristy
Faculty of Building & Architecture
P.O. Box 513
5600 MB Eindhoven
E-mail: m.b.c.aries@bwk.tue.nl

Regina Bokel
TU-DELFT
Berlageweg 1
Postbus 5030
NL-2600 GA Delft
E-mail: r.m.j.bokel@bk.tudelft.nl

Frans Taeymans
Etap Lighting B.V.
Tinstraat 7-4823 AA
Bredal
Postbus 3471
4800 DL Vreda
E-mail: frans.
taeymans@etaplighting.com

Ariadne Tenner
Philips Lighting B.V.
Building HBX
PO Box 80-020
5600 JM Eindhoven
E-mail: ariadne.tenner@Philips.com

New Zealand

Kit Cuttle
University of Auckland
Private Bag 92019
Auckland
E-mail: k.cuttle@auckland.ac.nz

Michael Donn and Werner Osterhaus
Victoria University of Wellington
Centre for Building Performance
P.O. Box 600
Wellington 1
E-mail: michael.donn@vuw.ac.nz
E-mail: werner.osterhaus@vuw.ac.nz

Switzerland

Nicolas Morel, Jean-Louis Scartezzini and Antoine Guillemin
Solar Energy & Building Physics Lab.
École Polytechnique Fédérale de Lausanne
1015 Lausanne
E-mail: nicolas.morel@epfl.ch
E-mail: jean-louis.scartezzini@epfl.ch
E-mail: Antoine.guillemin@epfl.ch

Sweden

Helena Bülow-Hübe
Lund University
Division of Energy and Building Design
Department of Construction and Architecture
P.O. Box 118
S-221 00 Lund
E-mail: helena.bulow-ube@ebd.lth.se

Nils Svendenius
Lund University
Department of Atomic Spectroscopy
Sölvegatan 14
S-223 62 Lund
E-mail: nils.svendenius@fysik.lu.se

Lars R Bylund
PELK Design Group
Drottningsgatan 71 C
SE-11136 Stockholm
E-mail: lars.r.bylund@telia.com

United Kingdom

John Mardaljevic
Institute of Energy & Sustainable Development
Leicester
UK LE7 9SU
E-mail: jm@dmu.ac.ukDevelopment

United States

William Carroll
Lawrence Berkeley National Laboratory
Mailstop 90 - 3026
Berkeley, California 94720
E-mail: WLCarroll@lbl.gov

Steve Selkowitz and Eleanor Lee
Lawrence Berkeley National Laboratory
Building 90-Room 3111
Berkeley, CA 94720
E-mail: seselkowitz@lbl.gov
Email: ESLee@lbl.gov

IEA Solar Heating and Cooling Address List

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
e-mail: john@jillibyfarm.com.au

AUSTRIA
Prof. Gerhard Faninger
c/o Universität Klagenfurt, IFF
Sterneckstraße 15
A-9020 Klagenfurt
Tel: +43/463/2700 6125
Fax: +43/463/2700 6199
e-mail: 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 21 42
Fax: +32/10/47 21 50
e-mail: deherde@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
e-mail: dmcclena@nrcan.gc.ca

DENMARK
Mr. Jens Windeleff
Danish Energy Authority
Amaliegade 44
DK-1256 Copenhagen K
Tel: +45/33/926 818
Fax: +45/33/114 743
e-mail: jew@ens.dk

Alternate
Mr. Poul E. Kristensen
IEN Consultants
Hasselvej 30
2830 Virum
Tel: +45/855 092
Fax: +45/855 092
e-mail: poulerik@adr.dk

EUROPEAN COMMISSION
Dr. Georges Deschamps
Commission of the European Union
DG Research
Rue de la Loi 200
B-1049 Brussels, BELGIUM
Tel: +32/2/295 1445
Fax: +32/2/299 3694
e-mail:
georges.DESCHAMPS@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-02150 HUT (Espoo)
Tel: +358/9/451 3197
Fax: +358/9/451 3195
e-mail: peter.lund@hut.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 79 11
Fax: +33/4/93 95 79 87
e-mail: yves.boileau@ademe.fr

GERMANY
Dr.Volkmar Lottner
Forschungszentrum Jülich - PTJ
D-52425 Jülich
Tel: +49/2461/61 48 79
Fax: +49/2461/61 31 31
e-mail: 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
e-mail: zampetti@casaccia.enea.it

JAPAN
Vacant

Alternate
Dr. Kazuki Yoshimura
Multifunctional Thin Film Group
Institute for Structural and Engineering Materials AIST
2266-98 Anagahora Shimoshidami Moriyama-ku
Nagoya 463-8560
Tel: +81/52/736 7305
Fax: +81/52/736 7315
e-mail: k.yoshimura@aist.go.jp

MEXICO
Dr. Isaac Pilatowsky
Centro de Investigation en Energia
Universidad Nacional Autonoma de Mexico
Apartado Postal #34
62580 Temixco, Morelos
Tel: +52/73/25 00 52
Fax: +52/73/25 00 18
e-mail: ipf@mazatl.cie.unam.mx

Alternate
Dr. Wilfrido Rivera Gomez-Franco
Centro de Investigation en Energia
Universidad Nacional Autonoma de Mexico
Apartado Postal #34
62580 Temixco, Morelos
Tel: +52/73/25 00 44
Fax: +52/73/25 00 18
e-mail: wrgf@mazatl.cie.unam.mx

NETHERLANDS
Mr. Lex Bosselaar
NOVEM
P.O. Box 8242
3503 RE Utrecht
Tel: +31/30/239 34 95
Fax: +31/30/231 64 91
e-mail: L.Bosselaar@novem.nl

NEW ZEALAND
Mr. Michael Donn
School of Architecture
Victoria University of Wellington
P.O. Box 600
Wellington 1
Tel: +64/4/802 6221
Fax: +64/4/802 6204
e-mail: michael.donn@vuw.ac.nz

NORWAY
Mr. Fritjof Salvesen
Norwegian Research Council
c/o KanEnergi AS
Hoffsveien 13
0275 Oslo
Tel: +47/22 06 57 73
Fax: +47/22 06 57 69
e-mail: fritjof.salvesen@kanenergi.no

PORTUGAL
Mr. Joao A. Farinha Mendes
INETI-Edificio G
Departamento de Energias Renovaveis
Estrada do Paco do Lumiar, 22
1649-038 Lisboa
Tel: +351/21/712786
Fax: +351/21/7127195
e-mail: farinha.mendes@ineti.pt

SPAIN
Mrs. Maria Luisa Delgado-Medina
(Vice Chair)
Head of Renewable Energy Department
CIEMAT
Avda Complutense, 22
Edificio 42
28040 Madrid
Tel: +34-91-346-60-50
Fax: +34-91-346-60-37
e-mail: luisa.delgado@ciemat.es

SWEDEN
Mr. Michael Rantil
(Chairman)
Formas – The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning
Box 1206
SE-111 82 Stockholm
Tel: +46/8/775 40 67
Fax: +46/8/775 40 10
e-mail: Michael.rantil@formas.se

SWITZERLAND
Mr. Urs Wolfer
Federal Office of Energy
CH-3003 Berne
Tel: +41/31/322 56 39
Fax: +41/31/323 25 00
e-mail: urs.wolfer@bfe.admin.ch

UNITED KINGDOM
Dr. Earle Perera
BRE
Bucknalls Lane
Garston, Watford
Herts WD2 7JR
Tel: +44/1923/664486
Fax: +44/1923/664095
e-mail: pererae@bre.co.uk

UNITED STATES
Mr. Drury Crawley
(Vice-Chair)
U.S. Department of Energy
Energy Efficiency and Renewable Energy, EE-2J
1000 Independence Ave. S.W.
Washington, D.C. 20585-0121
Tel: +1/202/586 2344
Fax: +1/202/586 4617
e-mail: Drury.Crawley@ee.doe.gov

OPERATING AGENTS

Task 22
Mr. Michael J. Holtz
Architectural Energy Corporation
2540 Frontier Avenue, Suite 201
Boulder, Colorado 80301 USA
Tel: +1/303/444 4149
Fax: +1/303/444 4304
e-mail: mholtz@archenergy.com

Task 23
Prof. Anne Grete Hestnes
Faculty of Architecture
Norwegian University of Science and Technology
N7491 Trondheim, NORWAY
Tel: +47/73/59 50 37
Fax: +47/73/59 50 45
e-mail:annegrete.hestnes@ark.ntnu.no

Task 24
Dr. Hans Westling
Promandat AB
Box 24205
S-104 51 Stockholm, SWEDEN
Tel: +46/8/667 80 20
Fax: +46/8/660 54 82
e-mail: hans.westling@promandat.se

Task 25
Dr. Hans-Martin Henning
Fraunhofer Institute for Solar Energy Systems
Heidenhofstr. 2
D-79110 Freiburg, GERMANY
Tel: +49/761/4588 5134
Fax: +49/761/4588 9000
e-mail: 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
e-mail: w.weiss@aee.at

Task 27
Mr. Michael Köhl
Fraunhofer Institute for Solar Energy Sytems
Heidenhofstr. 2
D-79110 Freiburg, GERMANY
Tel: +49/761 4016682
Fax: +49/761 4016681
e-mail: mike@ise.fhg.de

Task 28
Mr. Robert Hastings
Architecture, Energy &
Environmental GmbH
Kirchstrasse 1
CH 8304 Wallisellen, SWITZERLAND
Tel: +41/1/ 883-1717
Fax: +41/1/883-1713
e-mail: robert.hastings@aeu.ch

Task 29
Mr. Doug Lorriman
Namirrol Ltd.
38 Morden Neilson Way
Georgetown, Ontario
L7G5Y8 CANADA
Tel: +1/905/873 3149
Fax: +1/905/873 2735
e-mail: dpl@aztec-net.com

Task 31
Dr. Nancy Ruck
Department of Architectural &
Design Science
University of Sydney
Sydney NSW 2006 AUSTRALIA
Tel: +61/2/65 544 073
Fax: + 61/2/65 544 073
e-mail: 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
e-mail: hadorn@bluewin.ch

Task 33 Organizer
Mr. Werner Weiss
(see Task 26 for coordinates)

WORKING GROUPS
PV/Thermal Solar Systems
Mr. 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 73 04
Fax: +45/33/26 73 01
e-mail: h.soerensen@esbensen.dk

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
e-mail: pmurphy@
MorseAssociatesInc.com

ADVISOR
Dr. Frederick H. Morse
Morse Associates, Inc.
1808 Corcoran Street, N.W.
Washington, DC 20009, USA
Tel: +1/202/483 2393
Fax: +1/202/265 2248
e-mail: fredmorse@
MorseAssociatesInc.com

IEA SECRETARIAT LIAISON
Mr. Johan Wide
International Energy Agency
9 rue de la Fédération
75739 Paris Cedex 15, FRANCE
Tel: +33/1/40 57 6785
Fax: +33/1/40 57 6759
e-mail: johan.WIDE@iea.org

SHC INTERNET SITE
http://www.iea-shc.org