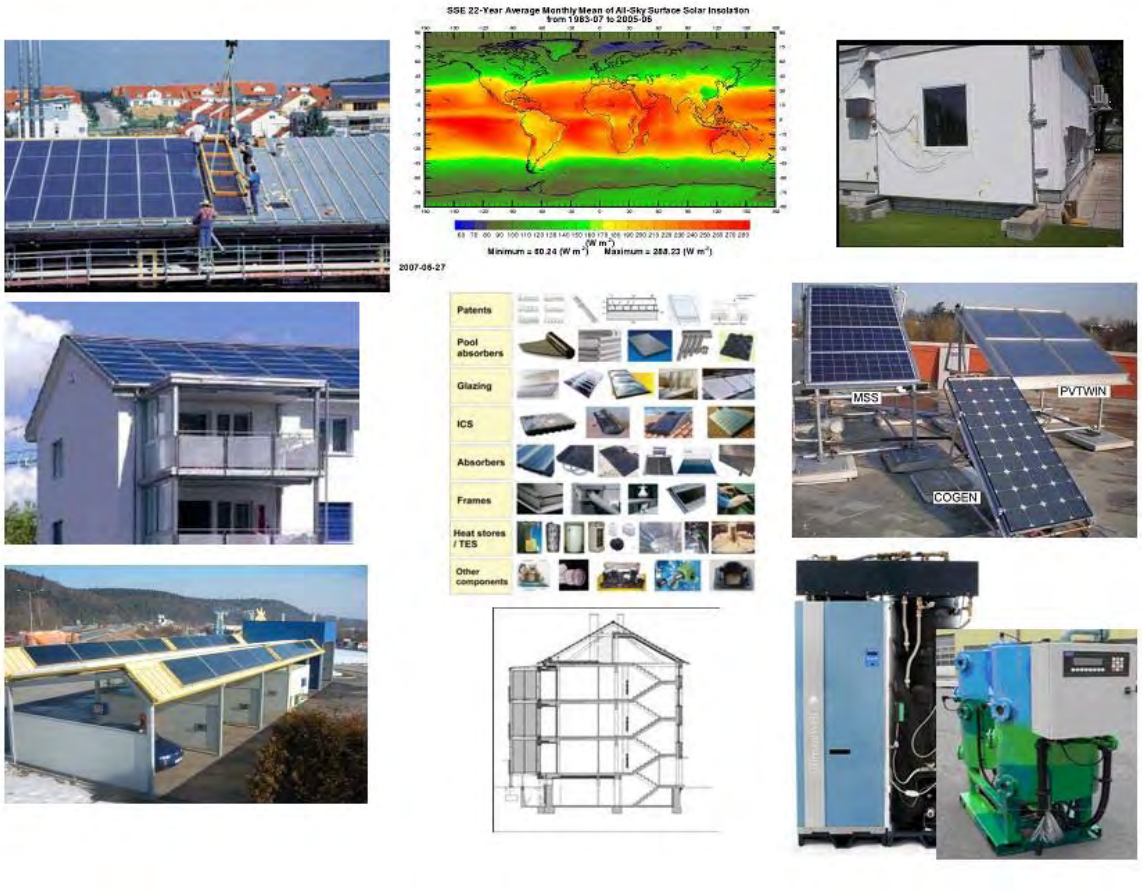
SOLAR HEATING & COOLING PROGRAMME

INTERNATIONAL ENERGY AGENCY



2008 Annual Report

With a Feature Article on Net Zero Energy Buildings

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

IEA Solar Heating & Cooling Programme

2008 Annual Report

Edited by
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Implementing Agreement

IEA

The *International Energy Agency* (IEA) is an autonomous body within the framework of the Organization for Economic Co-operation and Development (OECD) based in Paris. Established in 1974 after the first "oil shock," the IEA is committed to carrying out a comprehensive program of energy cooperation among its members and the Commission of the European Communities. The IEA provides a legal framework, through IEA Implementing Agreements such as the *Solar Heating and Cooling Agreement*, for international collaboration in energy technology research and development (R&D) and deployment. This IEA experience has proved that such collaboration contributes significantly to faster technological progress, while reducing costs; to eliminating technological risks and duplication of efforts; and to creating numerous other benefits, such as swifter expansion of the knowledge base and easier harmonization of standards.

SHC PROGRAMME

The Solar Heating and Cooling Programme (SHC) was established in 1977, as one of the first programmes of the International Energy Agency (IEA). The Programme's work is unique in that it is accomplished through the international collaborative effort of experts from Member countries and the European Commission. The benefits of such an approach are numerous, namely, it accelerates the pace of technology development, promotes standardization, enhances national R&D programmes, permits national specialization, and saves time and money.

The Programme is headed by an Executive Committee composed of one representative from each Member country and Sponsor organizations, while the management of the individual projects is the responsibility of project managers (Operating Agents) who are selected by the Executive Committee. Forty-two Tasks had been initiated since the beginning of the Programme. And, by the end of 2008, four Tasks were initiated.

The Programme's work is augmented through collaboration with other IEA Programmes, such as the Energy Conservation in Buildings and Community Systems Programme, the Photovoltaic Power Systems Programme, and the SolarPACES Programme, as well as solar trade associations in Europe, North America, and Australia.

SHC MEMBER COUNTRIES

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

Our Misson

The SHC mission for 2009-2013 is:

To advance international collaborative efforts for solar energy and provide significant added value to national R,D & D, and policy and program initiatives related to the built environment and for agricultural and industrial process heat to reach the goal set in the vision of contributing up to 50% of the low temperature heating and cooling demand by 2030.

This mission assumes a whole building approach to the application of solar technologies and designs. Based on this mission, the Programme will continue to cooperate with other IEA Implementing Agreements as well as the solar industry to expand the solar market. Through international collaborative activities, the Programme will support market expansion by providing access to reliable information on solar system performance, design guidelines and tools, data, etc. and by developing and integrating advanced solar energy technologies and design strategies for the built environment and for agricultural and industrial process heat applications.

To fulfill this mission, the Programme will direct its results to the design community, the solar manufacturers, and the energy supply and service industries that serve the end-users and building owners.

Our Objectives

The SHC Executive Committee has agreed upon the following objectives and associated strategies to fulfill its mission.

SHC Objective 1

To be the primary source of high quality technical information and analysis on solar heating and cooling technologies, designs and applications.

Strategies

- Assure that technical **information** and **analysis** developed in this Agreement is available and disseminated to the target audiences in useful formats.
- Working through relevant international standards organizations, support the development and harmonization of **standards** necessary for the widespread use of solar designs and technologies in the building, agricultural and industrial sectors.

SHC Objective 2

To contribute to a significant increase in the performance of solar heating and cooling technologies and designs.

Strategies

- Increase **user acceptance** of solar designs and technologies.
- Continue to develop **cost-effective** designs and technologies in collaboration with appropriate intermediary industries.

- Identify and prioritize **R&D needs** for solar heating and cooling that will lead to expanded markets

SHC Objective 3

To enhance cooperation with industry and government on increasing the market share of solar heating and cooling technologies and designs.

Strategies

- Work with appropriate **intermediary industries** and end users to accelerate the market penetration of solar designs and technologies.

- Work with governments to promote and expand **favorable policies** to increase the market share.

- Work towards or support the greater use of solar designs and technologies in **developing countries**.

- Work to address issues regarding building design, aesthetics and architectural value.

SHC Objective 4

To increase the awareness and understanding on the potential and value of solar heating and cooling systems by providing information to decision makers and the public.

Strategies

- **Communicate** the value of solar heating and cooling designs and technologies in publications, conferences, workshops and seminars to the public and relevant stakeholders.

- Provide **analysis** that links solar heating and cooling designs and technologies to energy security concerns, environmental and economic goals.

- **Quantify and publicize** the environmental, economic and climate change benefits of solar heating and cooling and supporting policy measures solar design and technologies in meeting environmental targets and addressing policies and energy, supply security.

- **Review** our products in relation to our objectives **–** Annual Reports, Solar Update Newsletters, National Programme Review Reports, "*Solar Heating Worldwide: Markets and Contributions to the Energy Supply report."* **Present** the SHC Solar Award annually/bi-annually. **Maintain** the SHC web site.

Chairman's Report

Doug McClenahan
CANMET – Natural Resources Canada

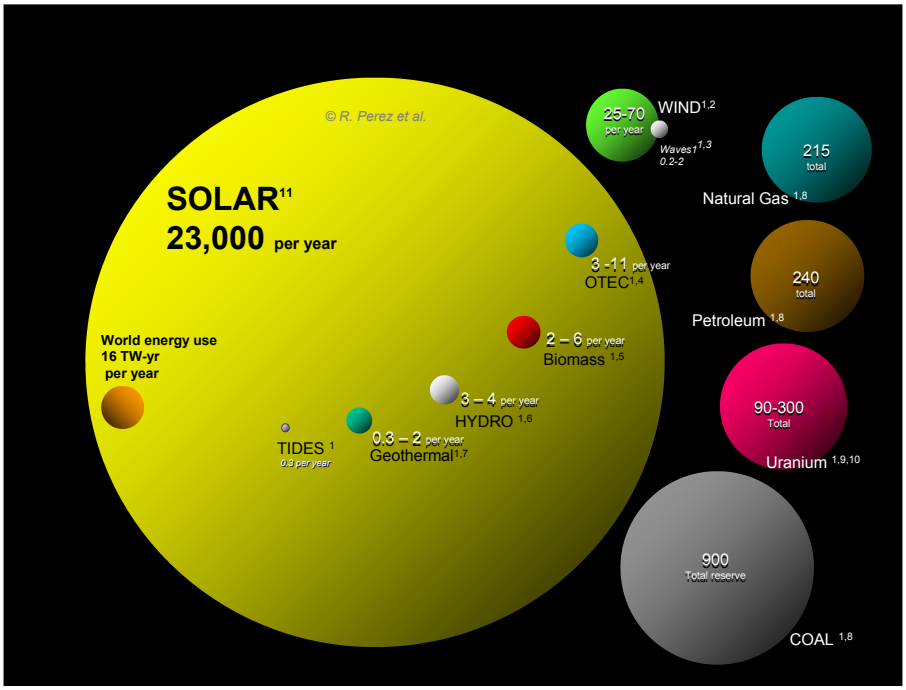
I am pleased to present the 2008 annual report of the IEA Solar Heating and Cooling Programme. In 2008 both the SHC Programme and solar thermal received important recognition. First, the IEA strongly supported the renewal of another 5-year term for this successful collaborative Programme. Second, solar heating and cooling continued to gain momentum as a critical renewable energy source. This broadening of renewables' scope beyond power generation was supported by the 1st joint ISES/SHC EuroSun 2008: International Conference on Solar Heating, Cooling and Buildings held in Lisbon, Portugal and the presentation of the 5th SHC Solar Award to Professor Manuel Collares Pereira of Portugal.

SOLAR THERMAL STATISTICS

The figure on the right compares the current annual energy consumption of the world to:
(1) the known reserves of the finite fossil and nuclear resources, and
(2) the annual potential of the renewable alternatives.

The volume of each sphere represents the total amount of energy recoverable from the finite reserves and the energy recoverable per year from the renewable sources.

As shown in the figure, the renewable sources are not all equivalent by far. The solar resource is orders of magnitude larger than all the others combined. Wind energy could probably supply all of the planet's energy requirements if pushed to a considerable portion of its exploitable potential. However none of the others, most of which



Comparison of finite and renewable planetary energy reserves (Terawatt-years). Total recoverable reserves are shown for the finite resources. Yearly potential is shown for the renewables. ***Source: Richard Perez, ASRC, University of Albany, NY, USA.***

are first and second order byproducts of the solar resource

– could, alone, meet the demand. On the other hand, exploiting only a very small fraction of the earth's solar potential could meet the demand with considerable room for growth.

To track the growth of solar thermal, the SHC Programme produces an annual statistics report, *Solar Heat Worldwide: Markets and Contribution to the Energy Supply*. The 6th edition reports that in 2006, solar thermal technologies produced **76,959 GWh** – an oil equivalent of 12.5 billion liters and annual avoidance of 34.1 million tons of CO_2 emissions.

Key findings:

- Installed capacity in 2006 was 127.8 GW_{th} (182.5 million square meters)
- Market penetration (installed capacity per 1,000 inhabitants) leading countries:
  - Cyprus 680 kW_{th}; Israel 506 kW_{th}; Austria 231 kW_{th}; Barbados 208 kW_{th} and Greece 207 kW_{th}
- Most dynamic markets:
  - China and Taiwan were the leader with an average growth rate of 22% annually between 1999 and 2005 and representing 44% of the world market.
  - Followed by 20% in Europe and 16% in Australia and New Zealand.
- Initial 2007 data estimates an annual collector yield of 154 GW_{th}.

Worldwide, we are just beginning to scratch the surface of the market for solar heating and cooling. If solar thermal installations increased by 20 fold we would just approach 1% of the annual world energy use as shown in the previous figure. The annual energy recoverable from solar, as shown in the previous figure, is more than one thousand times the current world energy use, so there is tremendous growth potential. However, in addition to technology innovation, we will need very dramatic changes in energy policies around the world in order to tap into this potential in a significant way in the near to medium term.

SHC TASKS

2008 was the start of exciting new work in the areas of net zero energy solar buildings, solar and architecture, thermal storage and solar standards and certification. The new work includes:

- Task 40: Net Zero Energy Solar Buildings is a joint project with the IEA ECBCS Programme that will work to develop a common understanding, methodology, tools, innovative solutions and industry guidelines.
- Task 41: Solar Energy and Architecture will focus on the combination of architectural quality and energy performance.
- Task 42: Compact Thermal Energy Storage: Material Development for System Integration is the first of its kind with an Operating Agent from the SHC Programme and from the IEA Energy Conservation through Energy Storage Programme to lead work on the development of advanced materials and systems for the compact storage of thermal energy.
- Work in the area of ratings and certification will begin in 2009. This will be the first solar standards and certification Task, and would bring together testing organizations from around the world to look at new testing standards and harmonization.

SHC SOLAR AWARD

The recipient of the *2008 SHC Solar Award* was Dr. Manuel Collares Pereira, founder and R&D Director of AO SOL, Energias Renováveis, S.A. and professor at the Technical University of Lisbon. Mr. Collares Pereira received the award at the ISES/SHC EuroSun 2008: 1st International Conference on Solar Heating, Cooling and Buildings in Lisbon, Portugal.

The *SHC Solar Award* is given to an individual, company, or private/public institution that has shown outstanding leadership or achievements in the field of solar heating and cooling, and that supports the work of the IEA Solar Heating and Cooling Programme.

Prof. Collares Pereira is the fifth recipient of the *SHC Solar Award*. He was selected for his extensive work in the field of solar. Beginning in the 1970s, Prof. Collares Pereira conducted pioneering work on the first CPC collector (Compound Parabolic Concentrators) prototypes with Prof. Roland Winston at the University of Chicago. He continued this work over the years until his involvement led to the first commercial production of CPC collectors in the world. To support his mission, Prof. Collares Pereira has founded numerous organizations, the most important being the Centre for Energy Conservation, the acting Portuguese Energy Agency.

COLLABORATION WITH OTHER IEA PROGRAMMES & INTERNATIONAL ORGANI ZATIONS

To support our work, the SHC Programme is collaborating with other IEA Programmes and solar organizations.

Within the IEA

IEA Energy Conservation in Buildings and Community Systems Programme is collaborating in SHC Task 40: Net Zero Energy Solar Buildings at a moderate level as outlined in our Policy & Procedures Handbook.

In addition, a joint meeting was held in Graz, Austria in June 20008. These meetings are held every 2-3 years. The next joint meeting will be held in 2010/2011.

IEA Energy Conservation through Energy Storage Programme is collaborating at a joint level as outlined in our Policy & Procedures Handbook in Task 42: Compact Thermal Energy Storage. This will be the first fully joint Task with Operating Agents from each Programme.

IEA Photovoltaic Power Systems Programme is collaborating in Task 36: Solar Resource Knowledge Management at a minimum level as outlined in our Policy & Procedures Handbook.

SolarPACES Programme is collaborating in Task 36: Solar Resource Knowledge Management at a minimum level as outlined in our Policy & Procedures Handbook.

Outside the IEA

Solar industry associations in Australia, Europe and North America are collaborating with the SHC Programme to increase national and international government agencies and

policymakers awareness of solar thermal's potential and to encourage industry to use solar thermal R&D results in new products and services.

To support this collaboration, a SHC/Trade Association meeting is planned for May 29, 2009.

EU ThERRA (Thermal Energy from Renewables – References and Assessment), the SHC Programme is represented on the Advisory board by Mr. Werner Weiss. The objective of this group is to develop and disseminate a methodology for monitoring the total amount of renewable heat produced in the EU.

ESTTP (European Solar Thermal Technology Platform), the SHC Programme, represented by Mr. Lex Bosselaar, continued to serve on the ESTTP Steering Group and to support the Platform's objectives.

EXECUTIVE COMMITTEE MEETINGS

2008 Meetings

The Executive Committee held two meetings:

- June 11-14 in Graz, Austria
  This meeting included a 30th anniversary celebration for the Programme and a joint meeting with the Energy Conservation in Buildings and Community Systems Implementing Agreement
- November 19-21 in Winterthur, Switzerland

2009 Meetings

The Executive Committee will hold two meetings:

- June 2-4 in Stavanger, Norway
- November to be decided

PROGRAMME PARTICIPATION – BENEFITS & HOW TO JOIN

Participation in the Programme remains strong with 18 Member countries and the European Commission actively involved in the Programme's management and the work of the Tasks. Communication with five target countries that have already been invited to join the Programme–Brazil, China, India, Japan and South Africa—continued. In 2008, the Executive Committee unanimously voted to invite Greece, Kenya and the United Arab Emirates to join the Agreement, and letters of invitation were sent.

The SHC Programme is unique in that it provides an international platform for collaborative R&D work in solar thermal. The benefits for a country to participate in this Programme are numerous and include:

HOW TO PARTICIPATE

To learn more

Visit our website—www.iea-shc.org—to read about our Tasks, to find publications, to contact Executive Committee members and project managers (Operating Agents).

To join

If your ***country is a Member*** of the Programme then contact the Operating Agent of the specific Task you are interested in joining or the Executive Committee member from your country.

If your ***country is not a Member*** of the Programme, but a government agency or an organization is interested in joining, please contact the SHC Secretariat for information.

If you represent an ***international industry association or international non-profit organization*** and are interested in joining as a Sponsor, please contact the SHC Secretariat.

- Accelerates the pace of technology development through the cross fertilization of ideas and exchange of approaches and technologies.
- Promotes standardization of terminology, methodology and codes & standards.
- Enhances national R&D programs thorough collaborative work.
- Permits national specialization in technology research, development or deployment while maintaining access to information and results from the broader project.
- Saves time and money by sharing the expenses and the work among the international team.

TO ANOTHER SUCCESSFUL YEAR

It is with pleasure to serve a 2nd term as Chairman. It has been an active year with new work starting in key solar areas, the presentation of the 5th SHC Solar Award, and the co-hosting of the 1st International Conference on Solar Heating, Cooling and Buildings.

I would like to take this opportunity to thank the following Executive Committee members, Manuel Romero as the Spanish member and Simonetta Fumagallia as the Italian member, for their dedicated service to the Programme's work.

2009 will bring new faces to the table, and to begin I would like to welcome Michele Zinzi of Italy. Those that joined us in 2008 were Mattias Törnell, Swedish member; Andreas Eckmanns, Swiss member; Enrique Soria Lascorz, Spanish alternate; Ivo Blezer, Dutch alternate; and Peter Donat, German alternate.

I look forward to our collaboration as we expand the work and impact of the SHC Programme. It is an exciting time as national and international interest and markets for solar heating, cooling, and daylighting technologies continue to grow.

Doug McClenahan

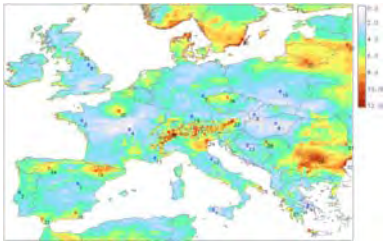
Task Highlights of 2008

Task 35: PV/Thermal Solar Systems

About 65 market survey interviews of architects and solar dealers were conducted in Canada, Denmark, Germany, Italy, Spain, Sweden, and the USA to obtain information from market actors on what affects or influences the purchase design, supply and installation of PV/T projects. An article under preparation for the magazine *Sun & Wind Energy* will present the analysis of the market survey interviews. The main conclusion of the survey is that both architects and solar companies are very interested in PV/T (e.g., for generating publicity and additional business). Opportunities for PV/T are generated by the limited roof space available, possible cost reduction (e.g., due to lower installation costs), building integration, and the fact that a PV/T system has a more uniform appearance than a side-by-side system.

This was a collaborative Task with the IEA Photovoltaic Power Systems Implementing Agreement.

Task 36: Solar Resource Knowledge Management



Task experts developed and tested a variety of solar resource forecasting methods. Utilities and system operators can use these forecasts to predict the approximate amount of energy they can rely upon over several hours to two to three days. An example of solar resource forecasting work being done in SHC Task 36 is the collaboration between CIEMAT (Spain), Oldenburg (Germany) and other institutions to evaluate the global solar radiation value of the WRF (Weather Research Forecasting) model for 40 monitoring stations in Spain for 2005 at a spatial resolution of 27 km. The study found that although the WRF model did not reproduce the synoptic conditions in Spain very well, particularly in partially cloudy climates. The ECMWF (European Centre for Medium Range Weather Forecasting) did reproduce the synoptic conditions in a much better way; thus it appears that local-scale solar forecasts potentially can be improved by using ECMWF results as boundary conditions for WRF model runs.

This is a collaborative Task with the IEA Photovoltaic Power Systems Implementing Agreement and SolarPACES Implementing Agreement.

Task 37: Advanced Housing Renovation with Solar & Conservation

Nine film clips on low energy houses and Passiv Houses were produced by SNØBALL Film with financial support from The Norwegian State Housing Bank and Enova SF. SHC Task 28, Sustainable Solar Housing and Task 37 made this project possible. The film clips can be viewed or downloaded at www.lavenergiboliger.tv. Four of these film clips are in English and German. Two of the

films were shown at the conference "Energy Efficiency in Housing: EU Tools to Unlock the Potential" organized by CECODHAS and EEB in Brussels in December2008.

Task 38: Solar Air Conditioning and Refrigeration

The Task's monitoring activities will include a series of small-scale machines with different technologies for cold production such as absorption with a liquid sorption material, adsorption with a solid sorption materials and even thermo-mechanical processes (novel Rankine cycle). To date, 23 small-scale systems have been identified for monitoring and evaluation. These systems cover all the relevant technologies and a broad range of climatic conditions. In addition, 12 large-scale systems have been identified to monitor. The large systems include nine closed water chillers and three open sorptive cycles (also known as DEC-systems) for direct treatment of fresh air (temperature and humidity control).

Task 39: Polymeric Materials for Solar Thermal Applications

Aventa AS of Norway successfully initiated a pilot production on an all polymeric collector. The absorber's twin-wall sheets use polyphenylenesulfide (PPS) provided by Chevron Philips of Belgium. Production of the absorbers is being conducted at Kaysersberg in France. Other activities on the development of polymer collectors include 1) production of polymer collectors by Soehner GmbH, Germany, 2) optimization of the absorber geometry by CFD simulations in HTCO GmbH and Fraunhofer ISE, Germany, 3) collector design by FH Ingolstadt, Germany, INES, France, and SPF, Switzerland, 4) over-heat protection by system design by Solartwin, UK, and 5) greenhouse collectors by Prirev, Portugal.

Task 40: Net Zero Energy Solar Buildings

The objective of this SHC Task is to study current net-zero, near net-zero and very low energy buildings and to develop a common understanding, a harmonized international definitions framework, tools, innovative solutions and industry guidelines. A primary means of achieving this objective is to document and propose practical NZEB demonstration projects, with convincing architectural quality. The Task will build upon recent industry experiences with net-zero and low energy solar buildings and the most recent developments in whole building integrated design and operation. This joint international research and demonstration activity will address concerns of comparability of performance calculations between building types and communities for different climates in the participating countries. The goal is solution sets that are attractive for broad industry adoption.

This is a collaborative Task with the IEA Energy Conservation in Buildings and Community Systems Implementing Agreement.

Feature Article

TOWARDS NET ZERO ENERGY SOLAR BUILDINGS (NZEBs)

Mark Riley, Operating Agent SHC Task 40
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Energy use in buildings worldwide accounts for over 40% of primary energy use and 24% of greenhouse gas emissions[1]. Energy use and emissions include both direct, on-site use of fossil fuels as well as indirect use from electricity[2], district heating/cooling systems and embodied energy in construction materials.

Given the global challenges related to climate change and resource shortages, much more is required than incremental increases in energy efficiency. Currently, a prominent vision proposes so called "net zero energy", "net zero carbon" or "EQuilibrium" buildings[3] (see Figure1) that feature very high levels of energy-efficiency combined with renewable energy technologies. Although these terms have different meaning and are poorly understood, several IEA countries have adopted this vision as a long-term goal of their building energy policies[4]. What is missing is a clear definition and international agreement on the measures of building performance that could inform "zero energy" building policies, programs and industry adoption around the world.

What Is Known About Achieving "Zero" In Buildings?

The first strategy is to reduce energy demand through suitable architectural design and improved building envelopes. Measures for achieving this depend on climate and building type and include insulation, improved glazings and daylighting, airtight building envelopes and natural ventilation as well as active or passive shading for control of solar gains. Improving the efficiency of energy systems and services through better heating, cooling and ventilation systems, controls and lighting is the corresponding strategy for efficient use of the energy supplied. The "Passive House"[5] reflects these concepts for cold and moderate climates.

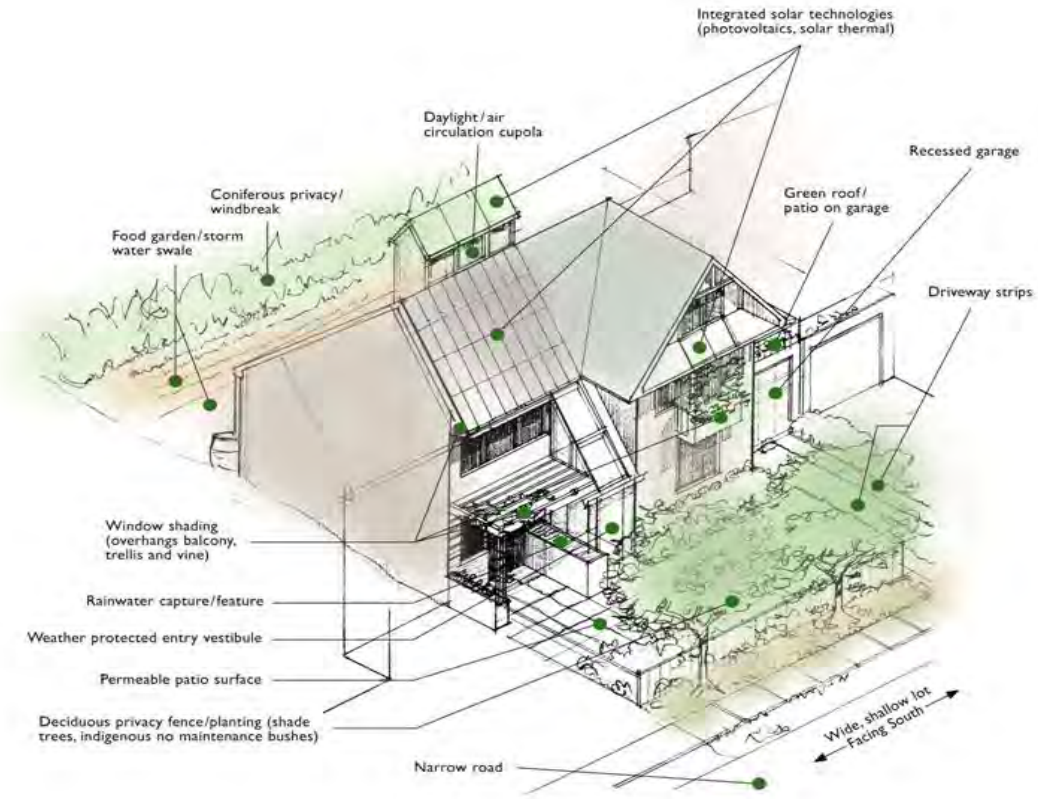
[1] IEA *Promoting Energy Efficiency Investments – case studies in the residential sector* ISBN 978-92-64-04214-8. Paris. 2008

[2] Note: In most countries, indirect emissions are not counted as emissions from the building sector but from the industry (power plants). This means the environmental footprint of building related energy use is often underestimated.

[3] Another ambitious approach was formulated with the 2000-W-Society and the resulting energy demand limits for buildings: Zimmermann, M*., Althaus, H.-J., Haas, A.: Benchmarks for sustainable construction – A contribution to develop a standard*, Energy and Buildings, 37, 2005

[4] Countries include: CA, DE, UK, USA, NL, NZ

[5] Dr. Wolfgang Feist, Passive House Institute, http://www.passiv.de



Source: Canada Mortgage and Housing

Figure1. EQuilbrium Net-Zero-Energy Healthy Housing Concept (http://www.cmhc.ca/en/inpr/su/egho/)

However, to reach "zero" use of fossil fuels or zero-carbon emissions requires intensive utilization of renewable energy concepts including solar heating, solar cooling, solar PV, biofuels or other clean energy generation sources.

The "Net Zero" Option

Zero energy buildings (ZEBs) are not a new concept (see Figure 2). An area of focus has been autonomous building energy options. With existing technology, this "off-grid" approach has been and still is a technical, economical and ecological challenge for most applications[6]. For example, seasonal and daily variations of demand and supply, at most locations worldwide, result in costly over-sizing of energy supply systems. As well, autonomous buildings require expensive thermal storage systems that can embody large amounts of energy relative to the small energy stored and efficient, long-term electrical storage is still not solved. Furthermore, most of these so-called ZEBs do require some "imported" energy for backup and high power density loads, such as cooking.

[6] Goetzberger, A., et. al., *The Self-Sufficient Solar House Freiburg*, Advances in Solar Energy, vol. 9, p.1-70, 1994.

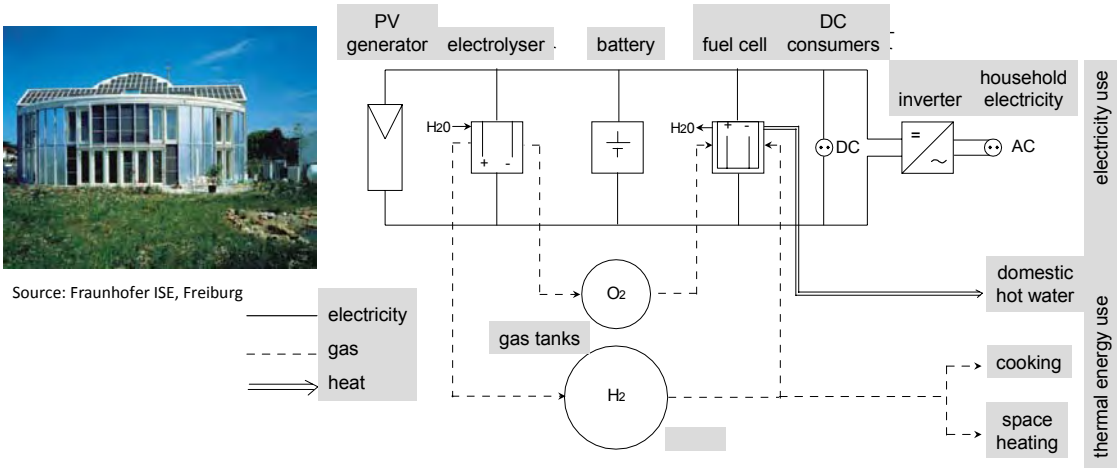


Figure 2. The Energy Autonomous House, Freiburg 1991.

Addressing the limitations of autonomous buildings, while still achieving "zero", leads to utility-connected solutions that optimize energy generation, distribution and storage. This "net zero" approach (NZEBs) still incorporates on-site renewable energy but the focus is on achieving an annual balance of energy supply and demand economically through interactions with electricity grids and other utilities such as community energy systems[7] (see Figure 3).

To minimize impacts to grids by reducing the mismatch of supply and demand, the NZEB approach requires a very high level of energy-efficiency, smart controls, load management and on-site solar energy utilization[8] (see Figure 4). This approach applies to the existing building stock as well as to new buildings, clusters of buildings and small settlements.

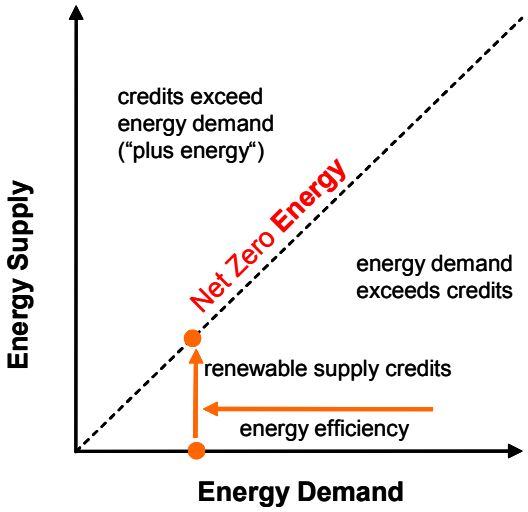


Figure 3. Net Zero Energy is achieved by reducing energy demand to be equal to clean renewable energy supply on an annual basis.

SHC Programme Work

In many IEA countries, NZEBs have been identified as having the potential to respond to

[7] Source for Figure 3: Professor Karsten Voss, University Wuppertal, Department Architecture, Building Physics and Technical Services.
[8] Source for Fig. 4: Super E Net Zero Energy House - http://www.super-e.co.uk/Homebuilders/casestudy.htm

global challenges related to climate change and resource shortages. However, much work is required to enable broad industry adoption of this concept.

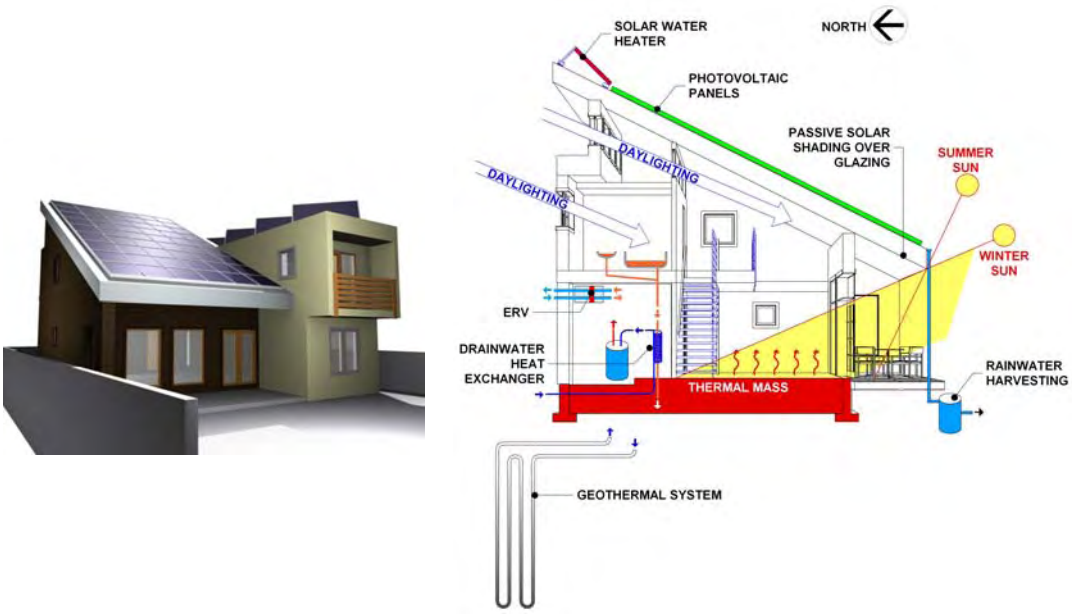


Figure 4. Tsuchiya Twoby Net-Zero-Energy Home, Sapporo, Japan.

The SHC Programme is undertaking a joint research activity with the IEA Energy Conservation in Buildings and Community Systems Programme. This work, SHC Task 40/ECBCS Annex 52, will bring together participants from approximately 20 IEA countries to propose solutions that are attractive for broad industry adoption. The Task will build upon recent industry experiences with net-zero and low energy solar buildings and the most recent developments in whole building integrated design and operation.

Participants will pursue integrated architecture and optimal integrated design solutions that provide good indoor environment for both heating and cooling situations. The process recognizes the importance of optimizing the design for the functional requirement, reducing loads and designing energy systems that pave the way for seamless incorporation of renewable energy innovations as they become cost-effective.

The Task will document and propose practical NZEB demonstration projects, with convincing architectural quality. These projects will aim to equalize their small annual energy needs, cost-effectively, through building integrated heating/cooling systems, power generation and interactions with utilities. It is believed that these exemplars and the supporting sourcebook, guidelines and tools will support and encourage industry adoption.

The first Task Meeting will be held in Montreal, Canada from May 6-8, 2009. This will be the start of the 4-year effort.

Task Reports

TASK 35: PV/THERMAL SOLAR SYSTEMS

Mr. Henrik Sørensen
Esbensen Consulting Engineers Ltd.
Operating Agent for the Danish Energy Authority

TASK DESCRIPTION

PV/Thermal Solar Systems combine photovoltaic technologies and solar thermal technologies into one system with both electricity and thermal energy output. The typical systems are solar collectors with photovoltaic systems integrated in the collector-surface or photovoltaic panels used as collector directly as solar air collector. Through combined production of electricity and heat, the overall efficiency can potentially be higher for a specific collector-area, than the efficiency of traditional "side-by-side" photovoltaic and solar thermal systems. The systems are typically integrated in the built environment.

The EU has set targets for 2010 of 100 million m^2 for solar thermal (corresponding to 70 $GW_{p\ thermal}$) and 3 GW_p for PV. The markets for both solar thermal and PV are growing rapidly globally, and PV/T has the potential to experience a similar growth since the technical potential of the technology is large, especially if the market for domestic applications can be reached. However, very few commercial PV/T manufacturers exist.

The objectives of Task 35 *PV/Thermal Solar Systems* are to catalyse the development and market introduction of high quality and commercial competitive PV/Thermal Solar Systems and to increase general understanding and contribute to internationally accepted standards on performance, testing, monitoring and commercial characteristics of PV/Thermal Solar Systems in the building sector.

The Task is organised in five subtasks, each focusing on the key issues identified being important to meet the overall objective of the Task.

- Subtask A: Market and Commercialisation of PV/T
- Subtask B: Energy Analysis and Modelling
- Subtask C: Product and System Development, Tests and Evaluation
- Subtask D: Demonstration Projects
- Subtask E: Dissemination

COLLABORATION WITH OTHER IEA PROGRAMMES

It has been agreed to collaborate with the Photovoltaic Power Systems Programme at a "minimal level" according to the SHC guidelines for coordination with other programmes. The Task is fully defined and managed by the SHC Executive Committee with appropriate input from the PVPS Executive Committee. National experts can be assigned to participate in the Task from both IEA SHC and IEA PVPS Executive Committee members or the participants can be accepted by sponsors of either of the two programmes.

Duration

The Task was initiated on January 1, 2005 and will be completed in the course of 2008, publishing final reports from the subtasks by mid 2009.

ACTIVITIES DURING 2008

All activities in 2008 were focused on concluding the work of the Task, in order to be able to publish the final reports of each subtask.

No new activities were initiated, but dialogues were initiated with several interested universities regarding the testing of simulation components developed in Subtask B and making use of Subtask A's results on emerging commercial systems.

Subtask A: Market and Commercialization of PV/T

About 65 market survey interviews of architects and solar dealers have been conducted in Canada, Denmark, Germany, Italy, Spain, Sweden, and the USA to obtain information from the market place about which things will affect or influence the purchase design, supply and installation of future PV/T projects.

An article under preparation for the magazine Sun & Wind Energy will present the analysis of the market survey interviews. The main conclusion of the survey is that both architects and solar companies are very interested in PV/T (e.g., for generating publicity and additional business). Opportunities for PV/T are generated by the limited roof space available, possible cost reduction (e.g., due to lower installation costs), building integration, and the fact that a PV/T system has a more uniform appearance than a side-by-side system.

A PDF file with an overview of commercially available PV/T collectors is available on the Task website.

Some work has been done internally to get an overview of the differences in grants and grants in various countries for PV and solar thermal systems.

Subtask B – Energy Analysis and Modeling

A draft report on PV/T, PV, and Solar Thermal Models was completed. The report describes the available simulation models, TRNSYS components and theoretical models.

Work was done on modifications for existing TRNSYS models for Water/Air PV/T collectors (type 50d) and Concentrating PV/T collectors (type 50h). A new model for a transpired air PV/T collector is about to be completed— a prototype has been built and tested, and comparison to the model is in progress. The PV/T collector models that can be completed in time will be compiled into a standard downloadable package of models for researchers.

Originally, it was expected that the Task would use the models for a standard downloadable package(s) or simulation program(s) for non-researchers based on TRNSED. However, another approach will be used here.

Development of a standardized method for characterization and monitoring of PV/T-modules is on-going and a report on the work will be completed in 2009. This deals with a method by which the thermal and electrical output of PV/Thermal collectors can be quantified. Three ways of rating are being proposed as mentioned below. The first rating scheme is very detailed and complex, but there is a decrease in detail and complexity as one goes down in the list:

- "design rating scheme"
- "technical rating scheme"
- "marketing scheme"

The development of control strategies needed for PV/Thermal Systems was discussed, but due to time and resource limitations an investigation of control strategies will not be made.

Figure 1. PV/T test stand at the University of Padova in Italy.

Subtask C: Product and System Development, Test and Evaluation

An MS Excel spreadsheet with an overview of PV/T components and projects has been completed and is available on the Task web site.

Flat plate glazed liquid PV/T collectors from the Dutch manufacturer PVTWINS, previously

tested at the Danish Technological Institute, and a prototype, COGEN, from Ecosolar Engineering, DTG in Italy have been tested at the University of Padova in Italy together with a unglazed liquid/air PV/T collector, MSS from Millennium Electric, Israel (see Figure 1).

Testing of a transpired air PV/T collector from Conserval Engineering, Canada, previously tested at the National Solar Test Facility in Canada, was performed at the Danish Technological Institute (see Figure 2).

Figure 2. Front and back view of two SolarWall® PV/T transpired air collectors, one thermal reference and one PV reference in the test stand at the Danish Technological Institute.

Testing of other categories of PV/T collectors have been carried out at Lund University in Sweden.

Different test methodologies based on the experiences from the participating laboratories and the PV Catapult deliverable D8-6: *PVT performance measurement guidelines* have been used. The aim of the activities is to achieve a much better understanding of the performance of already existing systems and to suggest standard methods for testing the characteristics and durability of PV/T collectors.

Regarding investigation of the need for development for PV/T components, industry, manufacturers, and designers have been asked and an overview of the R&D needs is being formulated.

The final reporting of Subtask C has been delayed for various reasons, but is expected to be completed by mid 2009.

Subtask D: Demonstration Projects

A combined report with experiences from interviews of stakeholders for realized PV/T systems and information on installed PV/T systems and monitoring is under preparation.

With regards to identifying potential new PV/T demonstration projects there have been inquiries from people in different countries. However, it has not been feasible to offer help

for planning, design and hosting of PV/T demonstration projects directly within the framework of Task 35. Individuals interested in realizing a PV/T system have been referred to manufacturers of PV/T collectors.

Subtask E: Dissemination

The internal Task web site is a key tool in the Task work. All documents produced within the Task and all communication within the Task 35 project group is uploaded here to facilitate dialogue between the Task experts and to provide a hub for information exchange on PV/Thermal Solar Systems.

The public Task web site http://www.iea-shc.org/task35 is continuously being updated to give access to Task results and information related to PV/T,

WORK PLANNED FOR 2009

The work in 2009 will focus on completing the remaining key deliverables.

Subtask C: Product and System Development, Test and Evaluation

The key report of Subtask C, report C4, will be finalized by mid 2009.

Subtask E: Dissemination

In the end of the Task period a Task brochure describing the aims and organisation of Task 35, the PV/T technology, and the final Task results will be made.

LINKS WITH INDUSTRY

Manufacturers of PV/T components have joined meetings and been active in the performance of work. By the end of the task, a special section of the website will be devoted to industry contacts to obtain the latest information available, especially regarding the testing of PV/T components.

REPORTS PUBLISHED IN 2008

No reports were published in 2008, but a number of documents and papers were made available on the Task web site.

REPORTS PLANNED FOR 2009

- DB1: Report on heat transfer and electric performance models in PV/Thermal Solar systems (*Title could be changed*)
- DB2: Report on recommended standard for characterisation and monitoring of PV/Thermal Solar systems. (*Title could be changed*)

- DC4: Tests of PV/T collectors and a suggestion for a method for performance measurements of PV/T collectors. (*Title could be changed*)
- DD2/DD3: Realized PV/T installations – experiences and monitoring results.

MEETINGS IN 2008

Web and telephone meeting

In April a web and conference call to plan the finalization of the remaining key deliverables, and subsequently a number of conference calls between the subtask-leaders and the OA were carried out.

MEETINGS PLANNED FOR 2009

Web and conference calls will be arranged in March and May 2009 to finalize the editing of the remaining reports.

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TASK 36: SOLAR RESOURCE KNOWLEDGE MANAGEMENT

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Operating Agent for U.S. Department of Energy

TASK DESCRIPTION

Goal and Objectives

The goal of SHC Task 36 "Solar Resource Knowledge Management" is to provide the solar energy industry, the electricity sector, governments, researchers, and renewable energy organizations and institutions with the most suitable and accurate information of the solar radiation resources at the Earth's surface in easily-accessible formats and understandable quality metrics. The scope of solar resource assessment information includes historic data sets and currently derived data products using satellite imagery and other means.

There are three main objectives of this Task to achieve this goal:

- To provide further standardization and benchmarking of international solar resource data sets to insure worldwide Intercomparability and acceptance
- To provide improved data reliability, availability and accessibility in formats that address specific user needs, and
- To develop methods that improve the quality and the spatial and temporal coverage of solar resource products, including reliable solar radiation forecasts.

Achieving these objectives would reduce the cost of planning and deploying solar energy systems, improve efficiency of solar energy systems by more accurate and complete solar resource information, and increase the value of the solar energy produced by solar systems.

Scope of the Task

This Task focuses on the development, validation, and access to solar resource information derived from surface-based and satellite-based platforms. The Task will investigate benchmarking and data quality assessment procedures for data products and validation data sets, examine means by which the data can be made easily available to users through various web-based hosting schemes, and conduct studies on improving the input data sets and algorithms from which satellite-derived products are produced, including the investigation of short term forecasting and past and future climatic variability of the solar resource.

The audience for the results of the Task includes the technical laboratories, research institutions and universities involved in developing solar resource data products. More importantly, data users, such as energy planners, solar project developers, architects, engineers, energy consultants, product manufacturers, and building and system owners and managers, and utility organizations, are the ultimate beneficiaries of the research, and will be informed through targeted reports, presentations, web sites, handbooks and journal articles.

Means

Task 36 participants are addressing the objectives through sharing a co-coordinated work plan encompassing three subtasks:

Subtask A: Standard Qualification for Solar Resource Products

The objective of this Subtask is to provide the user community with benchmarked, standardized, validated worldwide solar resource data sets. Key Subtask activities to meet this objective are:

- Select and Qualify Ground Data Sets (lead: NASA, USA)): this activity will include a survey and documentation of existing data sources, and the production and reporting of high-quality surface data sets with which to use in benchmarking and validating satellite-derived data sets.
- Define Measures of Model Quality for Product Validation (lead: H2Magdeburg, Germany): besides defining measures of model quality, this activity includes the establishment and documentation of model intercomparison procedures.
- Develop Methodology for Establishing Coherent Benchmarking of Products (lead: NASA, USA)
- Apply Benchmarking Procedures to Subtask C Products (lead: H2Magdeburg, Germany): this activity will provide results of benchmarking studies conducted on data sets provided by Task 36 participants

Subtask B: Common Structure for Archiving and Accessing Data Products

The objective of this Subtask is to provide a user-oriented information system, such as a distributed data system, for archiving and accessing solar resource data. Key subtask activities to meet this objective are:

- Evaluate the Legal Aspects of Accessing Solar Resource Data (lead: Armines, France): this activity focuses on establishing copyright and proprietary rights of data that will be made available through the distributed data system, and to establish appropriate protocols with each participating institution for making the data generally available to the public.
- Identification of User Requirements (lead: SUNY/Albany, USA and JRC, EU): this activity captures and examines needs expressed by users of the data and the outcomes are specifications for the information system, list of customers serving later as testers of the prototypes and guidance to subtask A for selection of algorithms and methods
- Develop Data Exchange Protocols and Metadata (lead: Armines, France): various data exchange protocols will be examined, and one will be selected and documented.
- Develop Prototype (lead: Armines, France): a prototype web-based system will be developed whereby a user can request information of a certain type and format, and the information system provides the response or responses that most closely addresses the request.
- Develop Network of Resource Providers (lead: NASA, USA): a worldwide network of data providers will be established, and the techniques for data exchange among the providers will be investigated.
- Develop Use of Prototype by Users (lead: Armines, France): this activity defines the prototype that can be accessed by users, and raises the awareness of the data exchange system to external users.
- Define Automatic Access by Commercial Applications (lead: NASA, USA): This activity will enable automatic and fast access of resources through the information

system by using commercial applications.

- Develop a Test Application (Solar Micrositing) (lead: JRC, EU): a case study in micro sitting of a solar energy system will be developed to demonstrate the benefits of the information system.

Subtask C: Improved Techniques for Solar Resource Characterization and Forecasting

The objective of this Subtask is to conduct essential R&D to improve the accuracy and the spatial and temporal coverage of current techniques, including the introduction of solar resource forecasting products. Key activities to meet this objective are:

- Improve Satellite Retrieval Methods for Solar Radiation Products (lead: SUNY/Albany, USA): This activity will focus on key model input parameters and methodologies, such as cloud indices, radiative transfer schemes, aerosol data retrievals, and treatment of snow and other surface albedo artifacts. The activity also addresses ways of improving the spatial resolution of satellite-derived broadband solar resource products.
- Conduct Climatological Analysis of Solar Resources (lead: NASA, USA): In order to ascertain future impacts on system performance due to climate variations, this activity includes the analysis of long-term surface and satellite-derived data sets and climate models; specifically addressing natural long-term fluctuations associated within the ocean-atmosphere system, such as the Southern Oscillation/El Nino.
- Evaluate Solar Radiation Forecasting Procedures (lead: EHF, Germany): This activity investigates different approaches for developing solar resource forecasts based on global numerical weather predictions and extrapolation of cloud motion vectors

Collaboration with other IEA Programmes

Knowledge on solar resources is highly important for all forms of solar energy applications. Therefore Task 36 is conducted as a collaborative Task together with the IEA Implementing Agreements SolarPACES (Solar Power and Chemical Energy Systems), which has been adopted as Task V in their program, and PVPS (Photovoltaic Power Systems). It was agreed by both partnering Implementing Agreements, that SHC coordinates the Task. Cooperation is based on "minimum level" according to the SHC "Guidelines for Co-ordination with other Programmes."

Task Duration

The Task was initiated July 1, 2005 and will be completed June 30, 2010.

ACTIVITIES DURING 2008

Overall Task Activities

Progress on all aspects of Task 36 continues to be made. Progress has improved since the implementation of the EU-funded program Management and Exploitation of Solar Resource Knowledge (MESoR), which parallels Task 36 activities and involves most of the European Task 36 participants. The Task will hold its sixth Task Experts Meeting in Baeza (Jaén), Spain on 17-19 March 2009, to be hosted by the University of Jaén and CIEMAT.

We continue to maintain collaboration with Solar PACES and with PVPS Implementing Agreements on a minimal level, according to SHC rules. Task 36 is also assigned as Task V

in Solar PACES. A key presentation on Task 36 was made by the Task's SolarPACES liaison, Dr. Richard Meyer of Epuron GmbH, Hamburg, at the semi-annual SolarPACES ExCo in Almería, Spain, November 4-7, 2008. A brief report was submitted for the PVPS ExCo meeting held on October 29-30; however we have learned that our task liaison, Ulrike Jahn, is not longer able to fill that role. We will be seeking a new liaison candidate either from the PVPS directly or from a participant of Task 36. The Task also continues to maintain liaison with the Global Earth Observation System of Systems (GEOSS) program, and maintains strong ties with other international activities such as Global Energy and Water Experiment (GEWEX), Project GAS (GMES Atmospheric Service), and SWERA, Solar and Wind Energy Resource Assessment, a Program of the United Nations Environment Programme's (UNEP's) Division of Technology, Industry, and Economics (DTIE).

Several Task 36 participants attended a meeting at UNEP/DTIE in Paris on July 9 to explore ways of linking Task 36 more formally to the IEA and to SWERA. Representatives from the IEA, the Global Wind Energy Council, GRID/Sioux Falls (where the SWERA archive is maintained) and REN21 also participated in this meeting. The outcome of this meeting was a strategic framework that will engage the IEA more closely. The Task 36 Web Portal designs, as well as PVGIS, were of great interest to UNEP for possible adaptation to the SWERA program.

Following completion of the updated 1991-2005 National Solar Radiation Database in 2007, NREL has updated the Typical Meteorological Year database using both the original 1961-1990 and 1991-2005 NSRDB data sets. The new data set is called TMY3.

Task 36 participants submitted a number of papers technical papers to the EuroSun 2008 First International IEA/SHC Conference, held on October 7-10 in Lisbon. Several technical papers were presented at a technical session chaired by the Task 36 Operating Agent, who also gave a keynote address on Climate and Solar Energy Availability. There were also a number of posters displaying Task 36 research results.

Several Task participants attended the Solar 2008 Conference in San Diego in June and gave papers on recent U.S.-developed solar products. There was also a solar resource forecasting forum, also attended by the Task participants. Several task members also participated in and gave presentations at the 23rd PVSEC in Valencia, Spain in October 2008.

Several Task participants contributed to the "IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing" (JSTARS) with special focus on Earth Observations and renewable energies. Task participants *T. Ranchin* of Mines ParisTech and *M. Schroedter-Homscheidt* of The German Aerospace Centre (DLR) served as guest editors for this issue.

Specific Technical Achievements

Subtask A: Standard Qualification of Solar Resource Products

The work accomplished and the preparations for further activities include:

Activity A1: Select and Qualify Ground Data Sets. Identification of high quality surfaced broadband and spectral solar measurement data sets continues. Data will be subject to a common formatting and QC procedure. Prototypes of formats (DLR) and QC (CIEMAT, DLR) will be discussed at the next task meeting. A first set of formats and QC have been defined as deliverable D1.1.2 existing ground data sets within the European MESoR Project.

The project has gathered a number of data sets from BSRN, IDMP and GAW, which have undergone the QC and are stored in a common format within the MESoR Wiki. Access has been granted additionally to the IEA Task participants. This document and the data collection will be extended to the IEA Task.

NASA Langley Research Center (LaRC) has completed an assessment of the BSRN quality control flags. Data from all BSRN sites spanning from 1992 to present were considered at the hourly average temporal interval (over 4 million hourly values). These flags are provided with the pyranometer (or global), direct normal, diffuse and total (direct horizontal + diffuse) measurements and provide a rudimentary assessment of the measurements. It was found that the QC flags are useful but insufficient to determine data quality, particularly at low sun conditions (i.e., large solar zenith angles) in the hours after and/or before sunrise/sunset. At those times direct/diffuse flux tests are inconclusive. If those measurements are screened, then biased daily averages result. The result of the assessment is that QC tests for low solar angle conditions are required.

The study also evaluated the sensitivity of using various assumptions regarding data gaps during the course of determining the hourly average. NASA LaRC found that applying additional QC testing beyond the BSRN QC flags is required. Figure 1 displays the progressive levels of quality control applied to one-minute averages for BSRN total (i.e., direct + diffuse) and unshaded pyranometer measurements for the Regina, Canada site. The top panels show comparisons without applying any QC (right) and then removing those points that failed BSRN QC quality flags. The procedures of Long and Shi (2008) were applied to total measurements values of 50 W-m^{-2} or greater (bottom left). These values less than 50 W-m^{-2} were then removed (bottom right). At this site, applying the BSRN QC plus the Long and Shi (2008) procedures remove about 15% of the data. However, removing the values less than 50 - m^{-2} removed an additional 15% of the data. The results of this procedure were presented to the BSRN bi-annual meeting in July 2008. Due to the large numbers of points removed for the low measurements, NASA continues to evaluate methods to provide some QC for low irradiance values, including extending the Long and Shi (2008) procedures to zero.

Upon completion of this study, a report of the findings will be submitted to Task 36 for evaluation and assessment of other high quality measurements. The result of these updated recommended procedures will be a survey of known QC procedures and the processing of all BSRN and similar high quality data sets with similar assumptions for the production of reliable surface validation data set. Similar approaches have also been developed for the Global Energy Balance Archive (GEBA) data sets containing monthly averaged solar irradiance measurements for sites distributed worldwide.

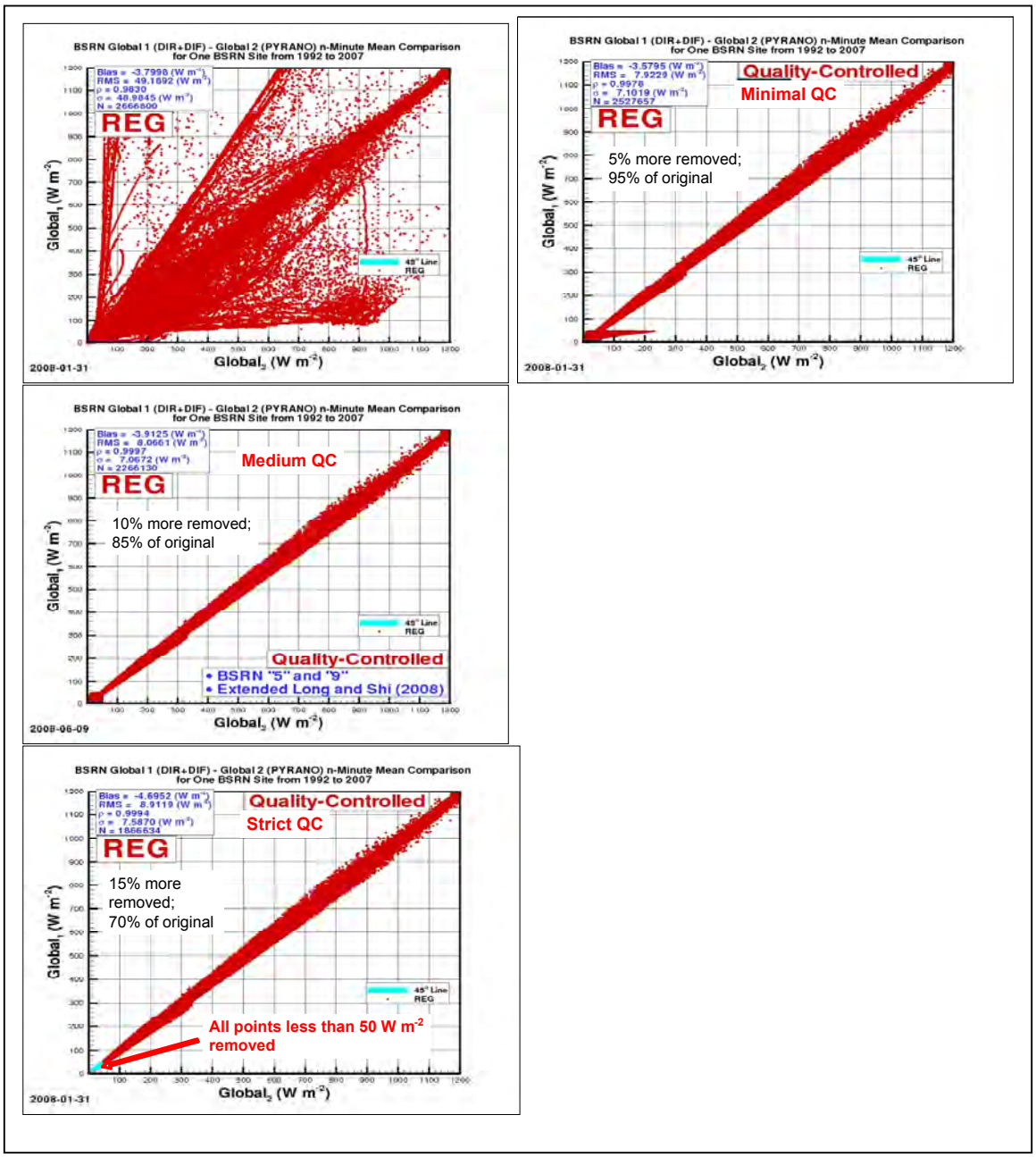

Figure 1. The top left panel shows an example of the comparisons of 1-minute averaged BSRN total (direct+diffuse, or "global 1") versus unshaded pyranometer measurements (global 2) for the BSRN site of Regina, Canada. The top right panel shows the result of applying the minimum BSRN standard of QC control eliminating data that fails the BSRN test. The bottom left panel shows the results of applying Long and Shi (2008) for fluxes < 50 W-m^{-2}. The bottom right panel shows the results of eliminating all data points < 50 W-m^{-2}. The reduction of hourly measurements resulting from the various applications of the QC criteria is shown.

Activity A2: Define Measures of Model Quality for Product Validation

A comprehensive report on Benchmarking solar radiation products has been prepared in the MESoR project as Deliverable D1.1.1 "Handbook on Benchmarking". It describes

benchmarking rules for time series products (1st and 2nd order), angular distributions, maps, and solar forecasts. This report will be the base for an extended IEA Task document.
NASA LaRC has applied new QC procedures to measurements and tested the impact of these of the validation plots relative to BSRN measurements. These improved surface measurements are leading to a better understanding of the uncertainties of the SRB/SSE fluxes at a variety of time scales. These will be finalized once the new QC procedures described above are completed and a report of these results will be submitted.

Activity A3: Develop Methodology for Establishing Coherent Benchmarking of Products.
Existing solar radiation products will be analyzed using the outcome of activity A2. Products to be analyzed include Meteonorm (UNIGE), Satel-light (ENTP), Helioclim (JRC, Armines), Solemi (DLR) and SSE (NASA). NASA SSE Release 6.0 is now available for use by Task participants to evaluate the use of these data in user product tools. . A methodology for map-based cross-comparison of spatial products was defined. It is based on the averaging of long-term averages, and uncertainty characterization from calculating of standard deviation.

Activity A4: Apply Benchmarking Procedures to Subtask C Products.
Benchmarking of newly- developed products, including solar radiation forecasts, has begun.

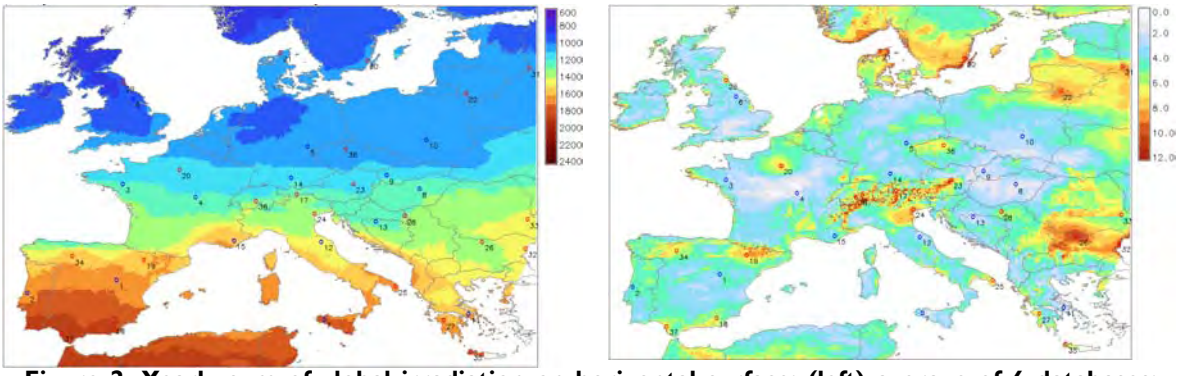

Figure 2. Yearly sum of global irradiation on horizontal surface: (left) average of 6 databases: Meteonorm v.6, ESRA, PVGIS, NASA SSE v.6, Satel-Light and HelioClim-2 [kWh/m2]; (right) standard deviation of the values from 6 databases relative to the overall average [%].

Subtask B: Common Structure for Archiving, Processing, and Accessing Resource
The work plan is being pursued in several areas. Recent accomplishments that highlight work progress include:

Activity B1: Evaluate the Legal Aspects of Accessing Solar Resource Data.
The document issued by GEOSS regarding data sharing principles is being reviewed. Task 36 will produce a similar document for the web portal in June 2009.

Activity B2: Identification of User Requirements.
This activity is now complete.

Activity B3: Develop Data Exchange Protocols and Metadata.
This activity includes the close monitoring of standardization procedures, investigation of available tools, their limits and advantages, and participation in international working groups,

such as INSPIRE (Europe) and GEOSS. A thesaurus has been adopted and an implementation is now available on the web site www.soda-is.com. A revision was made in July 2008. The thesaurus is used to develop the web services that are mentioned in Activity B4.

Activity B4: Develop Prototype.
As reported previously, a prototype of the proposed broker portal has been established within the MESoR project, and can be accessed at http://project.mesor.net. Not all the features are installed; the current prototype focuses on the demonstration of access to different solar radiation databases. At the time of writing six web services have been developed together with their interfaces. This demonstrates that the provision of services is possible in this standardized environment. Efforts are made to be fully compliant with GEOSS portals. Discussion is constantly held with the developers of these portals and other tools.

NASA SSE Release 6.0 contains numerous upgrades to increase data accessibility for uses including the output of global/region data sets, daily averaged time series and global/region plots in addition to the ASCII table output for specific locations. NASA has also populated its building integration web base prototype with newly released SSE 6.0 data. It has also provided data sets of global solar irradiance from a near-real time products. This prototype maintains the capability to generate unique user products like climate zone and psychrometric charts for building engineers/architects. NASA SSE Release 6.0 has now exceeded 73,000 unique registered users from 160 countries. As of October 1, 2008, there have been 9.5 million hits and 1.75 million data file downloads since the web site inception in 1997. The NASA group support SSE continues to collaborate with new users in the renewable and now electric power industry providing solar and meteorological parameters.

Activity B5: Develop Network of Resource Providers.
DLR has been supported by Ecole des Mines in setting up a web service of its SOLEMI solar resource database. A "how-to" manual was released in July 2008 to guide potential providers in developing web services that could be connected and accessed via the portal. At the time of writing, three web services are available at Armines: one from DLR, one from Meteotest and one from Meteocontrol. This demonstrates that the provision of services is possible. The efforts made for compliance with GEOSS portals and tools ensure that the web services developed for the IEA Task can be re-used and exploited in other cases by other portals at the will of the provider. Besides NASA, services from NREL, CanMet (Meteorology Canada) and the Australian Bureau of Meteorology will be sought.

Part of the NASA SSE Release. 6.0 data are now available in existing tools like SoDa for distribution. The NASA SSE has also committed to work with a team led by Ecole de Mines Paris for a GEOSS proposal activity.

Activity B6: Develop Use of Prototype by Users.
This activity will be fully developed in 2009. A facility has been established on the SoDa web site to gain input from users; this information will be relevant to the MESoR and Task 36 Web Portals. The PVGIS web application has been further expanded by implementing new analytical tools and enhancing the mapping interface using GoogleMaps API. The method of implementing raster maps into the web prototype was published by Cebecauer and Suri in the Open GEO journal.

Activity B7, Define Automatic Access by Commercial Applications.
This activity will enable automatic and fast access of resources through the information system by using commercial applications.

Activity B8, Example application using solar micro sitting in GIS.
This activity will be implemented from month 48 to month 60, i.e., the last year of the current Task 36 work plan.

Subtask C: Improved Techniques for Solar Resource Characterization and Forecasting

Activity C1: Improve Satellite Retrieval Methods for Solar Radiation Products.
Several task participants presented a paper at EuroSun 2008 outlining the uncertainties in solar radiative transfer models that result from inadequate characterization of key input parameters such as aerosols (see EuroSun paper # 406 referenced below).

DLR conducted a study on the accuracy of different satellite-based snow cover products, which are operationally available. Such datasets might be used in PV surveillance schemes to avoid false alarms due to snow cover on a PV system which is falsely taken as a system breakdown in sunny conditions.

Activity C2: Conduct Climatological Analysis of Solar Resources.
NASA LaRC has continued to lead several studies assessing the long-term variability of the recently-released 23 year GEWEX SRB data set (used also for SSE Release. 6.0). A scientific article detailing these findings was submitted in October 2008. Some of the following findings are noted from these studies: 1) SRB data set was shown to provide a general agreement with the time series of an ensemble of surface measurements from Global Energy Budget Archive (GEBA) indicating a decrease of solar irradiance over a large number of sites until about 1992, after which the fluxes at many sites increase. This is the so called "global dimming and brightening" phenomenon. Linear trends using the methodology of Weatherhead et al. (1998) that derives confidence intervals that consider the autocorrelation of the time series variability. An autocorrelation can falsely be interpreted as a trend and this method increases the width of the 95% confidence intervals considering the variability characteristics of the time series. Linear changes of globally averaged solar irradiance over the entire 22-year period (1983 - 2004) showed a long-term positive change but the confidence interval was shown to include 0. However, a piecewise analysis showed much stronger short-term changes that were significant (see Figure 3). This analysis showed that the time period from 2000 - 2004 actually gave a decrease. The alternating decreasing and increasing trends are more indicative of an overall atmospheric oscillation. 2) We studied an ensemble of long-term surface sites like from GEBA, where the surface sites are selected relative to a continuity requirement. The ensemble mean of these sites did correspond well with the variability from SRB for those grid boxes containing those sites, even given linear trends within the confidence interval. However, there was much less correspondence relative to the global mean from all SRB grid boxes. It was found that data gaps had significant effects on the trend calculations.

The BSRN network, which has fewer sites than GEBA, provides better representation of the global mean by containing sites in diverse locations. It was found that using the current 35-site configuration and using SRB to represent the fluxes at the BSRN locations (necessary because only 8 of the BSRN sites extend backwards to 1992), does provide variability that corresponds well with the actual global average.

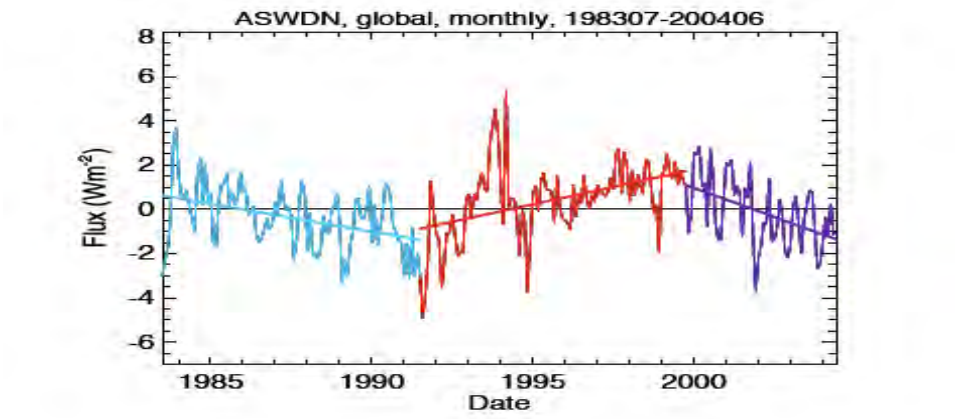

Figure 3. A piecewise analysis of the monthly globally averaged solar irradiance with seasonal variations removed, showing an oscillation between dimming, brightening and dimming again.

Activity C3: Evaluate Solar Radiation Forecasting Procedures.
SUNY/Albany has prepared a technical report on their NASA LaRC-funded task evaluating the Goddard Space Flight Institute Global Modeling and Assimilation Office (GMAO) forecasts. The model was tested using Hourly forecasts up to 60 hours for August and September 2007 for three BSRN/SURFRAD solar measurement sites in the U.S.: Goodwin Creek, Mississippi, Boulder, Colorado, and Desert Rock, Nevada. Software has been developed to process these data. In the latest progress report, it is shown that all forecast models handle clear sky conditions quite adequately, but that the performance of solar forecast models is highly dependent on their ability to predict cloud cover conditions accurately, as might be expected. Other models being tested include two versions of post-processing applied to ECMWF (European Center for Mid Range Weather Forecasting) global model irradiance forecasts by Oldenburg University, a version of the Weather Research and Forecasting (WRF) model being implemented by Meteotest, and the U.S. National Digital Forecast Database (NDFD). The performance of the various models varied from site to site.

Similar studies are being done in the Iberian Peninsula of Spain (see ref. Martin et al, EuroSun2008, paper # 284, below). Their studies also show that use of the ECMWF can improve WRF forecasting results. These authors have also developed studies showing the use of artificial neural networks to provide cloud cover forecasts (see ref. Martin et al, EuroSun 2008, paper #180 below).

ECMWF forecasts are also being used by Task participants to test the ability of providing forecasts of the output of ensembles of spatially diverse PV systems in Germany (se ref. Lorenz et al., PVSEC, below). Several approaches for deriving hourly forecasts from the 3-hourly ECMWF forecasts were tested. They have shown that a considerable improvement of the quality for regional irradiance forecasts can be achieved by correction of systematic deviations of original forecasts. A representative system model is proposed as a first approach for predicting the PV output of a large ensemble of systems.

Meteotest (Switzerland) has also been examining operation forecasting of PV power production in Europe as part of its Task 36 work. In a study also published in PVSEC (see

ref. Remund et al., below) they have studied results from the Global Forecast System, downscaled to a regional area using the WRF model. This study is being done in parallel with SUNY/Albany's U.S. study mentioned above.

DLR continued its work on method development for global and direct irradiance forecasting, combining satellite-based nowcasting, ECMWF deterministic and ensemble models and aerosol forecasting. A paper on concentrating solar power optimal operation strategies was published in the IEEE JSTARS journal (see above). Another paper by Rikos, Evangelos; Tselepis, Stathis; Hoyer-Klick, Carsten; Schroedter-Homscheidt, Marion about 'Stability and power quality issues in microgrids under weather disturbances: An implementation to the Kythnos island power system' was accepted for publication.

WORK PLANNED FOR 2009

Subtask A: Standard Qualification of Solar Resource Products

Activity A1: Select and Qualify Ground Data Sets

Solar radiation products will be benchmarked according to the newly defined quality measures for set of high quality ground station data. To cope with both, data and retrieval methods associated with 'historical' satellite data (e.g. Meteosat-7) and actual developments, the time periods of the ground data will on one hand refer to the period of 1996-2000 and on the other hand to the years from 2004 onwards.

In addition a data set with a dense spatial coverage, but lower quality of the irradiance data (irradiance measured by Solar-Cell-based sensors) is available for a region of Germany (~50 stations). As these sets will be applied within the European MESoR Project for further development of the retrieval tools, appropriate care has to be taken to allow for independent test of product quality.

Deliverables during this period will be benchmarking reports on radiations products (initiated by data providers) [May 2009] and a comparative compilation of benchmarking results (H2M) [June 2009]

Activity A2: Define Measures of Model Quality for Product Validation

In this activity two major thrusts will be undertaken: 1) Linking Benchmarking Measures to End Use Accuracy. In view of the end use accuracy of radiation products, the mitigation of the uncertainties of information on the irradiance to those of information on system performance has to be analyzed. For this purpose, the amplification (or, at best, reduction) of the relative uncertainties of estimated radiation sums to the relative uncertainties of the system performance measures (e.g. energy gain, system reliability) will be set in relation to the distribution-based second order quality measures (KST, RIO, etc). Depending on the response characteristics of the systems (deviations from linear response, existence of thresholds, etc.), the most appropriate quality measure will be identified. This will lead to additional criteria for the application dependent selection ranking of radiation products. The deliverable will be a report on end use accuracy (coordination: H2M) [June 2009]. 2) Extending the Benchmarking of Radiation Products to the Benchmarking of Environmental Data Sets. As most solar energy systems are sensitive to irradiance and temperature conditions, meteorological data sets used for the assessment of system performance have to reflect the combined statistics of irradiance and ambient temperature in a realistic way.

Thus, the set of quality measures derived for radiation products have to be extended the measures taking into account the combined statistical characteristics of irradiance and temperature sets (e.g. cross-correlation and conditional probabilities). As applied for the irradiance-only data sets, a benchmarking of existing products and procedures of combined irradiance/temperature information has to be performed and set in relation to the end use accuracy. For this purpose ground data sets including the combined information have to be selected. The deliverables will be a report on quality measures for combined data sets (H2M) [April 2009] and a report on benchmarking of combined products ((initiated by data providers) [June2009].

The German Ministry of Environment recently agreed to fund the project SESK, which aims to standardize the yield prognosis for solar thermal power plants. By June 2010 the main processes for bankable yield prognosis reports shall be defined and tested. The main emphasis is on high quality solar resource data, which shall be derived from satellite data and be verified by local measurements at the site. The project is coordinated by EPURON and involves DLR, Oldenburg University, H2M, and the certification institution TÜV Rheinland Energiesysteme.

Activity A4: Apply Benchmarking Procedures

Benchmarking of spatial (map) products of Direct Normal Irradiance will be finalized for the European subcontinent to provide a relative estimate of the user's uncertainty when assessing potential yearly energy yields. The data products of the following producers are considered: DLR (Solemi), University of Oldenburg, ENTPE (Satel-light), JRC (PVGIS), Meteotest (Meteonorm) and NASA (SSE).

Subtask B: Common Structure for Archiving, Processing, and Accessing Resource

Activity B1: Evaluate the Legal Aspects of Accessing Solar Resource Data

The document by GEOSS will be analyzed carefully as it represents the view of a large international community in Earth observation. Work will continue on the report, especially on the description of the system.

Activity B3: Develop Data Exchange Protocols and Meta-Data

The thesaurus will be exploited to develop web services. The thesaurus will be refined according to feedbacks from users of the information system and from providers of web services. NASA will provide any updates required for the latest SSE release 6.0.

Activity B4: Develop Prototype

Work will continue to develop the prototype, and to monitor its use by beta-testers. NASA will develop web services to provide access to the newly processed solar irradiance data plus an expanded list of parameters for the prototype web portal as it intends to continue to be a major solar resource provider. In 2009, Armines will translate all services available in the current SoDa service into the new standard for web services. Several tens of services should be available by the end of 2009.

Activity B5: Develop Network of Resource Providers

A revision of the *"How-to"* manual will be available in February 2009. Examples will be circulated among potential providers together with a document stating the benefits of becoming a provider in order to increase the number of available services.

Activity B6: Develop Use of Prototype by Users

Now that the prototype is populated with the six services, tests by users will begin on-line and with interviews in February 2009. Approximately 40 users In Europe have been targeted to begin with. A case study will be performed on NCEP forecasts to check their feasibility and discover major problems. NASA will work to identify potential users for testing/evaluation of Task 36 web sites and information systems.

The uncertainty in solar resource data for the PV estimation has been further analyzed and implemented in the PVGIS web system. The paper by Huld et al 2008 published in Progress in Photovoltaics discusses PV performance and the impact of time resolution of the solar radiation data. The second paper by Huld et al 2008 is also published in Progress in Photovoltaics discusses different PV mounting strategies and the impact of terrain shadowing on the different options.

Subtask C: Improved Techniques for Solar Resource Characterization and Forecasting

Activity C1: Improve Satellite Retrieval Methods for Solar Radiation Products

NASA will be working with other investigators to re-calibrate and reprocess the ISCCP data sets using brightest, coldest clouds and other new calibration techniques. This activity will better quantify the uncertainties of ISCCP cloud and radiance products that have been used to produce long-term solar resource data sets. NASA will also be pursuing a number of improvements for the current solar resource algorithms; the foremost of those are improvements to the optical representation of clouds and aerosols. Any improvements that these activities have make to the resulting solar resource estimates will be reported to the Task 36 participants.

In the course of the newly started German project SESK Oldenburg University and DLR will be revising their algorithms with the aim to produce higher quality beam irradiance data. In both cases the main improvement is expected by applying aerosol data of higher quality.

GeoModel and University of Jaen are finalizing work on models for upscaling and downscaling of satellite-derived direct and diffuse irradiance products using high-resolution digital elevation models.

Activity C2: Conduct Climatological Analysis of Solar Resources

NASA is continuing its participation in the GEWEX Radiative Flux assessment project that specifically considers long-term solar data sets for a climate analysis context. Identified uncertainties from this project will be used to better quantify uncertainties of the current resource products. In addition, NASA will be analyzing its latest long-term data set to quantify the variability at various temporal scales. A report pertinent to the solar industry first for the United States and then on a global basis will be produced.

Activity C3: Evaluate Solar Radiation Forecasting Procedures

The task participants will continue with the evaluation and further development of the different forecasting algorithms. Oldenburg University will extend their forecasting procedures to prediction of direct irradiance.

Focus of the next working period will be the benchmarking for Europe for the period July 2007 – June 2008. The participants of the corresponding countries will perform the comparison of the different forecast models for Spain, Southern Germany, Austria, and Switzerland. Six different forecasting approaches of Meteotest, Blue Sky, CIEMAT, University of Jaen, CENER, University of Oldenburg, and Meteocontrol will be compared.

At Meteotest, validation and comparison of the WRF forecast model with other models will be conducted in the area of southern Germany, Austria and Switzerland for the 1-year test period July 2007 – June 2008.

NASA plans to continue its partnerships with the NASA GMAO and SUNY/Albany to analyze solar forecasts for 2007 at specific selected sites. NASA will see that appropriate subsetting software is developed and delivered to SUNY/Albany, and will collaborate on interpreting the results. Lastly, NASA will work to continue the production of solar forecasts for the remainder of the study period as resources allow.

NREL working with SUNY/Albany will continue and expand the model intercomparison and validation work initiated with NASA. In particular a nation-wide systematic evaluation of short and medium term operational forecasts will be undertaken.

Environment Canada and Natural Resources Canada have partnered to evaluate the Canadian Meteorological Centre's GEM solar forecasts, and to develop and test photovoltaic power generation forecasts based on these. Global horizontal irradiance forecast data from April 2007 to June 2008 will be compared to observed irradiance at selected sites. These data will also be used to develop and test PV forecasting models, which will then be applied to Megawatt-scale PV parks in the province of Ontario. The data will also be used to compare GEM forecasts to those of other task participants at the U.S. sites selected by SUNY/Albany. Environment Canada will also evaluate the new solar forecasting model being implemented by the Canadian Meteorological Centre, which will include direct, diffuse and spectral irradiance forecasts.

DLR will continue its research work on coupling different information sources for an optimized direct irradiance forecasting with focus on the Mediterranean region.

Blue Sky (Austria) will validate the solar radiation forecasts for 5 locations in Austria using the forecasts of other task members and its own forecasts derived from 2 different methods: human meteorological cloud cover forecasts and a newly-developed statistical forecast (Blue Forecast). The second method will also be validated in other regions of Europe.

LINKS WITH INDUSTRY

Several small companies are directly participating in the Task: Epuron GmbH, Meteotest, Blue Sky, and recently a company formed by two Task participants, GeoModel. s.r.o. The audience for the results of Task 36 includes the technical laboratories, research institutions, and universities involved in developing solar resource data products. More importantly, data users, such as energy planners, solar project developers, architects, engineers, energy consultants, product manufacturers, and building and system owners and managers, and

utility organizations, are the ultimate beneficiaries of the research, and will be informed through targeted reports, presentations, web sites, handbooks and journal articles.

REPORTS AND PAPERS PUBLISHED IN 2008

National Solar Conference 2008 in San Diego (sponsored by the American Solar Energy Society), May 6-9, the following papers were presented:

Wilcox, S.; Marion, W.; Development Of An Updated Typical Meteorological Year Data Set For The United States.

P. Stackhouse, Jr., NASA Langley Research Center; T. Zhang, W. Chandler, C. Whitlock, J. Hoell, D. Westberg, R. Perez, and S. Wilcox, (2008): Satellite Based Assessment of the NSRDB Site Irradiances and Time Series from NASA and SUNY/Albany Algorithms

Chandler W., J. Hoell, D. Westberg, C. Whitlock, and T. Zhang, P. Stackhouse, Jr., (2008): Decadal Differences in Satellite Derived Solar and Meteorological Parameters.

23rd European Photovoltaic and Solar Energy Conference and Exhibition, Valencia, Spain, October 2008, the following papers were presented:

Remund, J., R. Perez and E. Lorenz, Comparison of Solar Radiation Forecasts for the USA.

Remund, J., C. Shilter, S. Dierer, S. Stettler, and P. Toggweiler, Operational Forecast of PV Production.

Lorenz, Elke, Johannes Hurka, Giota Karampela, Detlev Heinemann, Hans Georg Beyer, and Martin Schneider, Qualified Forecast of Ensemble Power Production by Spatially Dispersed Grid-Connected PV Systems.

Huld T., Suri M., Cebecauer T., Dunlop, E.D., 2008. Optimal mounting strategy for single-axis tracking non-concentrating PV in Europe.

XIV Congreso Ibérico and IX Iberoamericano de Energía Solar (CIES 2008), June 17-21, 2008, Vigo (Spain), the following papers were presented:

Gracia A.M, Torres J.L, de Blas M, Illanes R (2008): Comparación de las distintas clasificaciones de estados de cielo empleados en diferentes modelos de distribución angular de radiancia o luminancia.

Gracia A.M, Torres J.L, de Blas M, García A (2008): Comparación de medidas de distribución angular de radiación procedentes de dos equipos: Solar Igel y Sky Scanner.

Martín L., Zarzalejo L.F., Polo J., Navarro A., Marchante R. (2008): COMPARACIÓN DE TÉCNICAS PREDICTIVAS BASADAS EN SERIES TEMPORALES APLICADAS AL ÍNDICE DE CLARIDAD SEMIDIARIO.

1st International Conference on Solar Heating, Cooling and Buildings (EuroSun 2008), October 7-10 in Lisbon, Portugal, the following papers and posters were presented:

Pozo-Vazquez, D., V. Lara-Fanego, H. Al-Samamra, J. A. Ruiz-Arias, A. Molina, and J. Tovar-Pescador, (2008): Using NWP Models for Solar Radiation Estimates in a Complex-Topography area of Southern Spain (paper # 059).

H. Alsamamra, D. Pozo-Vazquez, J. A. Ruiz-Arias, V. Lara-Fanego, J. Hernández-Alvaro, and J. Tovar-Pescador, (2008): Mapping Solar Radiation in Southern Spain using Residual Kriging (paper # 060).

Hoyer-Click, C., H. G. Beyer, D. Dumortier, M. Schroedter-Homscheidt, L. Wald, M. Martinoli, C. Schillings, B. Geschwind, L. Menard, E. Gaboardi, L. Ramirez-Santigosa, J. Polo, T. Cebecauer, T. Huld, M. Suri, M. de Blas, E. Lorenz, R. Pfatischer, J. Remund, P. Ineichen, A. Tsvetkov, and J. Hofierka, (2008): Management and Exploitation of Solar Resource Knowledge (paper # 145).

Luis Martín, Luis F. Zarzalejo, Jesús Polo and Lourdes Ramirez (2008): Solar radiation forecasting with non-lineal statistical techniques and qualitative predictions from Spanish National Weather Service (paper #180).

Marcel Suri, Jan Remund, Dominique Dumortier, Lucien Wald, Thomas Huld, and Tomas Cebecauer, (2008): First Steps in the Cross-Comparison of Solar Resource Information in Europe (paper # 219).

Luis Martín, Elke Lorenz, A. Sood, Luis F. Zarzalejo, K. Suselj, Jesús Polo and Lourdes Ramirez (2008): Solar radiation forecasting with WRF model in the Iberian Peninsula (paper # 284).

Oumbe, Armel, Lucien Wald, and Marion Schroedter-Homscheidt, (2008): Exploitation of a Radiative Transfer Model for Assessing Solar Radiation: The Relative Importance of Atmospheric Constituents (paper # 406).

Steinmaurer, G.; The development of the simulation environment for the energy management of the solar assisted district heating grid in Wels (paper # 438).

Symposium Photovoltaische Solarenergie, in Bad Staffelstein, Germany, the following papers were presented:

Heinemann D., Drews A., Hammer A., Lorenz E.: "Energiemeteorologie – Ein Überblick am Beispiel der Photovoltaik"

Lorenz E., Hurka J., Heinemann D., Beyer H.G., Schneider M.: „Weiterentwicklung von Verfahren zur Solarleistungsvorhersage - Prognose von Verbundleistungen und deren Vertrauensbereiche" (Posteraward)

Beyer H.G. et al. "Bereitstellung gütebewerteter Datenbasen und Modelle zur Einstrahlungsklimatologie im Rahmen des Europäischern Projekts MESoR"

Remund J.: "Genauigkeit der Meteonorm Version 6.0"

Remund J. : "Stand der Strahlungsprognosen mit lokalen Vorheragemodellen"

Biennial Solar-PACES Symposium, March 4-7, 2008 in Las Vegas, Nevada, the following presentation was given:

Meyer, R., Butron, J.T., Marquardt, G., Schwandt, M., Geuder, N. Hoyer-Klick, C., Lorenz, E., Hammer, A. Beyer, H.G. (2008): Combining Solar Irradiance Measurements and Various Satellite-Derived Products to a Site-Specific Best Estimate.

Peer-reviewed Task papers in the IEEE Journal of Special Topics in Earth Observations and Remote Sensing, issue on renewable energies were:

Application of Satellite Sensor Data and Models for Energy Management, *E. Zell, J. Engel-Cox, R. Eckman,* and *P. Stackhouse, Jr.*

Case Studies on the Use of Solar Irradiance Forecast for Optimized Operation Strategies of Solar Thermal Power Plants, *M. Wittmann, H. Breitkreuz, M. Schroedter-Homscheidt,* and *M. Eck*

Reaching Consensus in the Definition of Photovoltaics Capacity Credit in the USA: A Practical Application of Satellite-Derived Solar Resource Data, *R. Perez, M. Taylor, T. Hoff,* and *J. P. Ross*

Geographic Aspects of Photovoltaics in Europe: Contribution of the PVGIS Website, *M. Súri, T. Huld, T. Cebecauer,* and *E. D. Dunlop*

Additionally, the paper "Rikos, Evangelos; Tselepis, Stathis; Hoyer-Klick, Carsten; Schroedter-Homscheidt, Marion about 'Stability and power quality issues in microgrids under weather disturbances: An implementation to the Kythnos island power system' was accepted for publication in a later issue of the IEEE Journal of Special Topics in Earth Observations and Remote Sensing.

Papers developed at the Joint Research Center in Ispra, Italy:

Huld T., Šúri M., Dunlop E.D., 2008. Geographical variation of the conversion efficiency of crystalline silicon photovoltaic modules in Europe. Progress in Photovoltaics: Research and Applications, 16, 595-607.

Huld T., Šúri M., Dunlop E.D., 2008. Comparison of Potential Solar Electricity Output from Fixed-Inclined and Two-Axis Tracking Photovoltaic Modules in Europe. Progress in Photovoltaics: Research and Applications, 16, 47-59.

Cebecauer T., Šúri M., 2008. Exporting geospatial data to web Tiled Map Services using GRASS GIS, OSGeo Journal, vol. 5

Papers published in the journal *Solar Energy*:

McKenney D.W., Pelland S., Poissant Y., Morris R., Hutchinson M., Papadopol P., Lawrence K., Campbell K (2008): Spatial insolation models for photovoltaic energy in Canada, Solar Energy, Volume 82, Issue 11, November 2008, Pages 1049-1061.

Drews A., H.G. Beyer, U. Rindelhardt (2008), Quality of performance assessment of PV plants based on irradiance maps, Solar Energy, Volume 82, Issue 11, November 2008, Pages 1067-1075

Espinar B., L. Ramírez, A. Drews, H.G. Beyer, L. F. Zarzalejo, J. Polo, L. Martín (2009), Analysis of different error parameters applied to solar radiation data from satellite and

German radiometric stations, Solar Energy, Volume 83, Issue 1, January 2009, Pages 118–125

Pierre Ineichen (2008) Conversion function between the Linke turbidity and the atmospheric water vapor and aerosol content. Solar Energy, Volume 82, Issue 11, November 2008, Pages 1095-1097

Pierre Ineichen (2008) Comparison and validation of three global-to-beam irradiance models against ground measurements. Solar Energy, Volume 82, Issue 6, June 2008, Pages 501-512

Pierre Ineichen (2008) A broadband simplified version of the Solis clear sky model. Solar Energy, Volume 82, Issue 8, August 2008, Pages 758-762

Papers published in *Progress in Photovoltaics: Research and Applications*:

Huld T., Šúri M., Dunlop E.D., 2008. Geographical variation of the conversion efficiency of crystalline silicon photovoltaic modules in Europe. Progress in Photovoltaics: Research and Applications, 16, 595-607.

Huld T., Šúri M., Dunlop E.D., 2008. Comparison of Potential Solar Electricity Output from Fixed-Inclined and Two-Axis Tracking Photovoltaic Modules in Europe. Progress in Photovoltaics: Research and Applications, 16, 47-59.

Other publications:

Cebecauer T., Šúri M., 2008. Exporting geospatial data to web Tiled Map Services using GRASS GIS, OSGeo Journal, vol. 5

Two large format PV Potential and Solar Radiation maps (posters) have been published by EC JRC – 3rd edition of the European map and 2nd edition of the map of Africa and the Mediterranean Basin.

MEETINGS IN 2008

Fifth Experts Meeting
June 9-11
Wels, Austria

Project MESoR Meeting
December 11-12
Geneva, Switzerland

MEETINGS PLANNED FOR 2009

Sixth Experts Meeting
March 17-19
Baeza (Jaén) Spain
This meeting will focus on a review of Task activities and results in preparation for developing the final Task deliverables; there will also be discussions of extending the Task beyond July 2010 with additional scope.

Seventh Experts Meeting
Late summer/early fall 2009
Location TBD

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TASK 37: ADVANCED HOUSING RENOVATION WITH SOLAR AND CONSERVATION

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TASK DESCRIPTION

Buildings are responsible for up to 35 percent of the total energy consumption in many of the IEA participating countries. Housing accounts for the greatest part of the energy use in this sector. Renovating existing housing offers an enormous energy saving potential.

The Task objective is to develop a solid knowledge base on how to renovate housings to a very high energy standard and to develop strategies which support market penetrations of such renovations. Task 37 will include both technical R&D and market implementation as equal priority areas.

The Task will begin by analyzing the building stock in order to identify building segments with the greatest multiplication and energy saving potential. Examples of building segments are year of construction, type of buildings, type of envelope and components. Within these segments important topics for discussions are: - ownership and decision structures, inhabitants and their characteristics and actual groups of retrofit market players.

In parallel, exemplary renovation projects achieving substantial primary energy savings while creating superior living quality, will be analyzed. Important aspects are both energy performance and the owner's motivations behind the renovation. Drawing on this experience package of measures in combination with the most updated research front, new and innovative concepts and components will be developed.

Insights from this international collaboration will be conveyed to target national end users in a deliberate strategy to increase the market penetration of advanced housing renovations.

The Task is organized into four Subtasks.

Subtask A: Marketing and Communication Strategies *(Lead country: Norway)*

This Subtask is planned to be a cross-Task activity to:

- Focus national Task activities on building types and solutions with the greatest multiplication and energy saving potential.
- Develop concrete market strategies together with companies, authorities, research institutes or other market players participating in the Subtask.
- Develop communication plans in accordance with the strategies to maximize the impact of knowledge gained through the Task.

Subtask B: Advanced Projects Analysis *(Lead country: Switzerland)*

This Subtask's objectives are to:

- Systematically analyze and document projects meeting Task selection criteria in order to quantify which measures achieve the greatest energy savings or non energy benefits and at what costs.
- Identify innovative, promising concepts for detailed analysis in Subtask C.
- Provide guidance for national R&D activities by identifying weaknesses and opportunities in high-performance housing renovations.

Subtask C: Analysis and Concepts *(Lead country: Germany)*

This Subtask will start with the analysis of advanced projects (in Subtask B) and then develop new concepts also using new components and systems. Accordingly, the objectives are to:

- Evaluate the performance of advanced housing renovation projects, characterizing performance using methods developed in SHC Task 28.
- Assess the adaptability of new energy supply systems, including renewable energy systems, as part of comprehensive renovation packages.
- Analyze new products and concepts for advanced housing renovations and provide manufacturers feedback to optimize products.
- Develop and publicize optimized renovation concept packages

Subtask D: Environmental Impact Assessment *(Lead country: Belgium)*

The Subtask will piece together quantifiable and qualitative results to obtain a comprehensive picture of the effectiveness of housing renovation approaches. It will assess the impact of the approaches taken in a selection of advanced housing renovation projects on:

- The environment
- The (urban) infrastructure
- Health, safety and quality of life

Task Deliverables

The results of the Task will be brochures and technical reports describing:

- Housing segments with the greatest multiplication and energy saving potentials [A].
- Design and performance of exemplary renovation projects, describing benefits, process and motivations [B]
- Packages of technically and economically robust concepts for housing renovation which could be applied in concrete projects [C]
- Innovative future solutions with great potential of primary energy reduction [C]
- A "basics" on sustainable renovation including principles for the design and realization of renovation projects, connecting the technical point of view at the project scale to factors of a larger scale (environment and resources, infrastructure and equipment, health and well-being) [D]
- Strategies for increased market penetration of housing renovation in selected market segments [A]

Duration

The Task was initiated on July 1, 2006 and will be completed on December 31, 2009.

ACTIVITIES DURING 2008

Two Task Expert meetings were held in 2008, April in Harleem, the Netherlands and September in Trondheim, Norway.

The day before the Expert meeting in Harleem, an afternoon Subtask D workshop was organized where the draft booklet was presented and discussed. The Fréquel-Fontarabie housing renovation project (French) was presented together with the Sterrenveld advanced housing renovation (Belgium). The workshop was attended by Task participants as well as some external experts.

The day after the Expert meeting in Trondheim, a full day open conference on housing renovation with the title: "The climate challenge calls for dramatic energy measures in existing housing" was organized. The conference program was based on presentations from Task 37 participants. The conference was well attended by approximately 80 persons from industry, architects and consulting engineers, local and regional authorities and researchers.

Contacts with the ECBCS Annex 50

The Expert meeting in Harleem was visited by Mr. Mark Zimmermann who is the OA of ECBCS Annex 50: Prefabricated Systems for Low Energy Renovation of Residential Buildings. He made a presentation of their work and possible items for collaboration were discussed.

The OA of Task 37 made a return visit to the ECBCS Annex 50 on October 21 in Liege where the Task was presented for the Annex 50 experts. At this meeting further collaborative topics were discussed.

Exemplary Renovation Brochures

The public web site www.iea-shc.org/task37 includes 12 brochures of exemplary housing renovations (Austria, Belgium, Switzerland, Germany, Italy and Sweden). The brochures show reductions in the heat demand from 62-95%, with an average of 75%. Many of these projects include a solar heating system for domestic hot water and space.

Housing Renovation Films

A set of films about housing renovations have been developed with special funding from Norway. These films are available from www.lavenergiboliger.tv.

The following are available in English and German language:

- Why low energy? (4 minutes)
- Low-rise flats, Nuremberg (17 minutes)
- Housing cooperatives for passive housing, Sweden (16 minutes)
- Municipal assistance, Norway (12 minutes)

EuroSun 2008, October 7-10 in Lisbon, Portugal

Robert Hastings gave a keynote presentation, "Advanced Solar Housing Renovation".

Sebastian Herkel presented the paper, "Analysis of energy supply strategies in housing retrofit" and Fritjof Salvesen gave an overall Task 37 presentation, "Advanced Housing Renovation with Solar and Conservation". The Task brochure was printed and distributed at the SHC stand.

Examples from the Demonstration Projects

This Italian villa in Modena is under historic preservation. The solution was to build masonry wall on the room side of the existing wall. The cavity between it and the old wall is insulated with coconut and cork panels, 40 and 60 mm thick, reducing the U-value from 1.75 to 0.25 W/m²K. New insulating glass windows were installed on the room side of the old windows to preserve the character of the facade. Primary energy demand for space and water heating is reduced 81% from 367 to 70 kWh/m². The old 104 kW boiler could be replaced by a 35 kW condensing gas boiler. 12 m² of vacuum tube collectors on the south façade of the interior court space help cover this reduced energy demand.

From 1963-1973 about one million apartments were built in Sweden under "the million-programme". Now 30-40 years later, they are in great need of renovation. In Alingsås, 300 of these apartments will be renovated to passive house standard.
A special feature is to move the balconies to hang outside the facades to decrease thermal bridges. Each apartment has its own air-to-air heat exchanger with 85% heat recovery efficiency. Heat is delivered to the apartments by the air system with an air to air heat exchanger. Heat for space heating and domestic hot water is supplied by solar collectors and district heating. The annual energy demand for space heating and hot water was reduced from 145 to 55 kWh/m².

WORK PLANNED FOR 2009

This is the final year of Task 37 and a lot of work to complete the Task will be accomplished. Internet meetings will be organized in between the regular Expert meetings.

The cross country summary report on buildings stock analyses will be completed before the May meeting. This summary report will point out similarities, interesting findings as well as opportunities and barriers. Interesting results from some reports outside Task 37 will also be included, like the EU ERA-Build report, "Building Renovation and Modernization in Europe: State of the art review".

The work on market strategies and communication plans will continue. Ongoing national strategy projects will be presented using the template form Task 28 success stories, adjusted to include the so called "6 step strategy model". The work on market segments with the highest potential will be continued until the next meeting with several SKYPE conference calls.

Subtask B will finalize the cross analysis of the projects which have been documented as brochures. Skeleton for publishing the set of buildings, cross comparisons and lessons learned will be discussed at the next meetings. More exemplary renovation brochures will be made and uploaded on the website.

Different technical solutions are addressed in subtask C as well as whole building concepts and the cross analysis of realized projects. A comprehensive layout of the content structure including responsibilities for each chapter of a technical report has been agreed. Most chapters, which should be able to stand on their own, will be finalized during 2009.

Subtask D will continue the work of the booklet, which will include 30 sheets, introduction, appendixes and glossary. In April 2009, a completed English version of the booklet will distributed and then discussed at the May Experts meeting in Canada.

LINKS WITH INDUSTRY

One third of the Task experts are representing companies and organizations working very close with the housing industry.

The Task will focus on marketable technical solutions, and the market strategies will help the market players to identify the most promising housing segments with the highest potential for renovation projects.

There are also links with the housing industry on the national level. As an example, Norway has established a national Task 37 project. This is organized as a collaborative effort with more than 15 stakeholders from the building sector working together with the Norwegian Task 37 experts. These stakeholders are both manufacturers, consultancies, building contractors, housing cooperatives and local authorities.

REPORTS PUBLISHED IN 2008

Twelve brochures of exemplary housing renovation projects are available for downloading on the Task page pf the SHC web site.

REPORTS PLANNED FOR 2009

- Several new brochures of Task 37 demonstration projects will be available from the public web site.
- The final results from the building stock analyses including a cross country summary will be reported.
- A publication presenting marketing strategies will be available late 2009.
- Several chapters of the Subtask C Technical report will be available
- The booklet "Sustainable renovation basics" will be presented at the October workshop.

MEETINGS IN 2008

4th Experts Meeting
April 17-18
Harleem, the Netherlands

5th Experts Meeting
April 16
Trondheim, Norway

Subtask D workshop
Harleem, the Netherlands
September 23-24

MEETINGS PLANNED FOR 2009

6th Experts Meeting
May 18-22
Waterloo, Canada
It is expected that the Canadian hosts will organize a national workshop in connection with the meeting.

7th Experts Meeting
During the week of October 12-16
Antwerp, Belgium
A national housing renovation seminar will also be organized in connection with this meeting.

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SHC TASK 38: SOLAR AIR-CONDITIONING AND REFRIGERATION

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TASK DESCRIPTION

In many regions of the world, room air-conditioning is responsible for the dominant part of electricity consumption of buildings. Electrically driven chillers cause high electricity peak loads in electricity grids, even if systems are used that reach a relatively high standard concerning energy consumption. This is becoming a growing problem in regions with cooling dominated climates. In addition, conventional air-conditioning systems apply refrigerants which show significant greenhouse impacts. SHC Task 38 is working on environmentally sound solutions for building air-conditioning and refrigeration using solar thermal energy to operate thermally driven cooling cycles.

The main objective of SHC Task 38, Solar Air-Conditioning and Refrigeration, is the implementation of measures for an accelerated market introduction of solar air conditioning and refrigeration with a major focus on improved components and system concepts. The market introduction will be supported through:

- Activities in development and testing of cooling equipment for the residential and small commercial sector.
- Development of pre-engineered system concepts for small and medium size systems and development of optimized and standardized schemes for custom made systems.
- Reports on the experiences with new pilot and demonstration plants and on the evaluation and performance assessment procedure.
- Provision of accompanying documents supporting the planning, installation and commissioning of solar cooling plants.
- Analysis of novel concepts and technologies with special emphasis on thermodynamic principles and a bibliographic review.
- Performance comparison of available simulation tools and applicability for planning and system analysis.
- Market transfer and market stimulation activities, which include information letters, workshops and training material as well as the 2nd edition of the Handbook for Solar Cooling for Planners.

The Task is organized with four Subtasks:

Subtask A: Pre-engineered systems for residential and small commercial applications *(Lead country: Austria)*

The objective of Subtask A is to support measures for the development of small and medium size pre-engineered systems, characterized by:

- Cooling capacity < 20 kW.

- A high degree of pre-fabrication of the entire system.
- No additional effort in planning is required for this type of systems.
- Pre-engineered systems, consisting in general of solar collector, storage, back-up system, chiller, heat rejection and control unit as the main components, can be connected directly to the room components by the installer.

Subtask B: Custom-made systems for large non-residential buildings and industrial applications *(Lead Country: Italy)*

The objective of Subtask B is to overcome the main technology related barriers for a wider implementation of medium and large scale systems for solar assisted cooling, characterized by:

- Cooling capacity > 20 kW.
- Individually planned systems for the particular application with involvement of planning engineers.
- Call for tender typically for single components and not for the system as a whole.

The target markets will be large air-conditioning and refrigeration end-users (large office and other non-residential buildings, hotels, industry etc.).

Subtask C: Modeling and fundamental analysis *(Lead Country: France)*

The main objectives of Subtask C are:

- Further development and evaluation of new and already existing component models and simulation tools with special regards to their applicability to different stages of the design process.
- Evaluation of novel and advanced solar cooling concepts which are still in a state of R&D and not yet ready for installation and market introduction.
- Thermodynamic analysis of solar cooling technologies using different methods such as exergy analysis.

Subtask D: Market transfer activities *(Lead Country: Italy)*

The main objectives of Subtask D are:

- To identify promising markets for solar air-conditioning and refrigeration technology.
- To ensure that the findings of the Task work are transferred to the important target audiences.

One of the major results with input from work of the entire Task will be a 2nd edition of the Handbook for Solar Cooling for Planners.

Main Deliverables

The results of the Task will be several technical reports and tools like the followings:

- State-of-the-art report describing market available cooling equipment in the desired capacity range in a comparative and standardized way
- Installation and maintenance guidelines for pre-engineered/package systems
- Overview of market available thermally driven cooling technologies and suitable new solar components

- Soft tool package for the fast pre-design assessment of successful projects
- Analysis tools for the theoretical and technical assessment of new concepts
- Technical report with developed certification and standardization schemes
- Second edition of the Solar Cooling Handbook for Planners

Duration

The Task started on September 1, 2006 and will be completed by December 31, 2010.

ACTIVITIES DURING 2008

- The 4th Experts meeting was held on April 1-2 in Vienna, hosted by Arsenal Research. Sixty-two experts attended the meeting.

- A Conference, "Sustainable Cooling Systems – Part 1: Solar Cooling" was held before the Experts meeting on March 31st. The workshop was divided into presentations concerning initiatives for solar cooling, technologies for solar air-conditioning and refrigeration, market and economics and future developments. The content of the presentations were based on the results of Task 38 and on the results of the ROCOCO project. More than 100 external participants, mainly professionals from Austria, attended the Conference.

- The 5th Experts meeting was held on October 6-7 in Lisbon, hosted by INETI. Seventy experts attended the meeting.

- After the Experts meeting, EuroSun 2008, 1st International Conference on Solar Heating, Cooling and Buildings was held from October 7-10 in Lisbon. Many Task 38 experts participated in the conference and 17 papers related to Task 38 work were submitted.

Results in 2008

- The monitoring activities are progressing, especially because most of the monitored systems started operation in summer 2008. The procedures for the description and the evaluation of the field tests were discussed and a 3-level evaluation procedure was agreed upon that extends to DEC applications. It comprises the following steps:
    - First level: basic information on primary energy ratio (PER) and costs
    - Second level: basic monitoring procedure (solar energy source management)
    - Third level: advanced monitoring procedure (detailed performance analysis)

- At the meetings in 2008, the first monitoring results of five installations were presented, and in most cases, the monitoring will be continued. Together with Subtask A and Subtask B, a common report describing the monitoring procedure was elaborated upon and then provided to the participating partners. This work was also presented at the EuroSun 2008 conference as a paper.

- At the 4th Experts meeting, a lecture on exergy analysis was given to interested participants and the working document on exergy analysis of solar cooling was presented and further developed for the 5th Experts meeting.

WORK PLANNED FOR 2009

In General

The 6th Experts meeting will be held on April 27-28, 2009 in Freiburg, Germany.

In connection to the Experts meeting a joint workshop of Task 38 with Annex 34 "Thermally Driven Heat Pumps for Heating and Cooling" of the IEA Heat Pump Program is planned for the April 29, 2009.

Subtask A: Pre-Engineered Systems for Residential and Small Commercial Applications

- Final report on "Market overview of components and systems in the small capacity range" finished and final report prepared
- Final report on generic system schemes
- Report on evaluation procedures
- Questionnaire for end-users concerning installation and maintenance guidelines

Subtask B: Custom-Made Systems for Large Non-Residential Buildings and Industrial Applications

- Final report on DEC systems
- Final report on Absorption and Adsorption technologies
- Final report on system control
- Final monitoring procedure will be elaborated as basis for the monitoring evaluation
- Final document on guidelines for installation and commissioning
- Beta-version of a Pre-design tool for system design in an early project phase distributed and tested among participants

Subtask C: Modeling and Fundamental Analysis

- Further work on the document / technical report about "Exergy analysis of solar cooling"
- Final report on comparison of simulation tools for DEC-technology
- Draft report on simulation tools and first validation with experimental facilities
- Draft report on heat rejection
- Elaboration of an evaluation procedure for different technologies

Subtask D: Market Transfer Activities

- Draft report on LCA of conventional and solar driven systems
- Report on overall performance and cost assessment methodology
- Updated TOC of second edition of Solar cooling handbook for planners with contribution of the results of the subtasks
- Organization of industry workshops
- e-Newsletter for the industry
- Final version of training material for installers and planners

LINKS WITH INDUSTRY

A number of the Task experts are representing companies active either in the planning and installation of solar thermal systems or the manufacturing of key components such as thermally driven cooling systems. In addition, many involved R&D institutes are closely co-operating with companies, mainly start-up companies, active in developing new small-scale thermally driven cooling machines (water chillers, open cycle systems). The Task also contributes to workshops addressing professionals working in the design and installation of HVAC and solar systems for buildings.

REPORTS PUBLISHED IN 2008

No reports were published in 2008 that are available to the public.

REPORTS PLANNED FOR 2008

- Report on existing components for small systems
- Report on generic system concepts of small systems
- Report on market overview of large systems
- Report on system design and control of large systems
- Report on comparison of simulation tools for DEC-systems
- Report on thermodynamic analysis

MEETINGS IN 2008

4th Experts Meeting
April 1-2
Vienna, Austria
In connection with the ROCCOCO/IEA SHC Conference on Solar Cooling on March 31.

5th Experts Meeting
October 6-7
Lisbon, Portugal

Most of the Task 38 Expert meeting participants took part in EuroSun 2008, in Lisbon, Portugal from October 7-10. At the conference, 17 presentations related to Task 38 were given.

MEETINGS PLANNED FOR 2009

6th Experts Meeting
April 27-29
Freiburg, Germany

7th Experts Meeting
September 28-29 (to be confirmed)
Palermo, Italy

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TASK 39: POLYMERIC MATERIALS FOR SOLAR THERMAL APPLICATIONS

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TASK DESCRIPTION

The objective of this Task is the assessment of the applicability and the cost-reduction potential by using polymeric materials and polymer based novel designs of suitable solar thermal systems and to promote increased confidence in the use of these products by developing and applying appropriate methods for assessment of durability and reliability.
These goals will be achieved by either less expensive materials or less expensive manufacturing processes.

The Task's objectives shall be achieved in the following Subtasks:

Subtask A:	Information	(Norway, Michaela Meir)
Subtask B:	Collectors	(France, Philippe Papillon)
Subtask C:	Materials	(Austria, Gernot Wallner)

Subtask A: Information

The objective of Subtask A is to collect, create and disseminate information about the application of polymeric materials in solar thermal systems and their figures or merits, especially in terms of cost/performance ratios for an acceptable lifetime, in order to increase the penetration of good applications into the market.

The production of a yearly newsletter, targeted at the solar- and polymer industry, a colored flyer for promotion of the Task and the preparation of an electronic or printed handbook on polymeric materials in solar thermal applications are to be main results of this Subtask.

Activities

- Provide a state-of-the-art overview of existing applications of polymeric materials in solar thermal systems and other relevant industry sectors.
- Investigate standards, regulations and guidelines with regard to the applications of polymeric materials in solar thermal systems and building integration.
- Analyze the challenges of polymeric materials in solar thermal applications from a market perspective
- Disseminate information of the work and results in all Subtasks to a wide audience

These activities will be carried out within 4 different projects:

- Project A1: State of the art: Polymeric materials in solar thermal applications
- Project A2: Standards, regulations and guidelines

- Project A3: Challenges of polymeric materials in solar thermal applications from a market perspective
- Project A4: Dissemination of information

Subtask B: Collectors

As the full potential of polymeric materials can only be used when several product functions are integrated into a single component in a fundamentally new design (in contrary to the simple substitution of materials), the work in this Subtask is based on a review and a detailed definition of technical and economic parameters for collectors and the development of novel designs of collectors.

The concept development and the following verification phase with the demonstration of examples should therewith lead to different, polymeric material oriented, collector designs. The benefits of these could be the replacement of expensive materials (e.g. copper), enhanced freedom of design, realization of cost potentials or the integration of several functions into the collector structure.

Considering the prospects of the use of polymeric materials this Subtask will focus on the following areas:

- integrated collector structure
- collector absorber for new solar thermal system designs
- thermo-syphon and storage collector systems
- unglazed collectors

The objectives of this Subtask are:

- To analyze the state-of-the-art in polymer based solar collectors and to derive and define the requirements to collectors in given applications.
- To develop concepts for easy to handle, mass producible polymer based collectors with promising prospects regarding costs.

Activities

The main activities will include a comprehensive state of the art analysis of solar collectors made from plastics and the system requirements.

In a second step, novel designs are development based on both, new system designs and new materials, for absorbers and entire collectors. Design examples will be produced in order to show the feasibility, performance, durability and cost savings.

These activities will be carried out within 2 different projects:

- B1: Integrated Collector Structure
- B2: Absorber

Subtask C: Materials

Polymer engineering and science offers great potential for new products and applications, which simultaneously fulfill technological and environmental objectives as well as social needs. The main components of a solar thermal system are the collector (glazing and absorber), pipes, fittings and pumps, and a storage unit. Polymers are already widely in use for solar thermal systems with an operating temperature range up to 30°C (water

preheating and swimming pool heating). For solar thermal domestic hot water systems with intended maximum service temperatures up to 90°C only few polymeric parts and components have been developed and introduced into the market. A main reason is that efficient, spectrally selective glazed flat plate collectors reach stagnation temperatures up to about 200°C, which are not in agreement with the nominal operating temperature range of solar thermal systems for domestic hot water applications. However, if the nominal operating temperature range is ascertained, nearly any component of a collector system can be realized by commodity and engineering plastics with material costs ranging from 1 to 10 €/kg. For a solar thermal system both structural and functional materials are needed. While the main requirement of structural materials is to carry mechanical loads, and thus the mechanical properties are of prime importance, functional materials are defined as solids with special mass and/or energy transfer properties.

An important aspect of all research activities in this Subtask will be the strong focus on the performance, functionality and durability of polymer products with respect to the application in solar thermal systems. As with other materials, final product performance, functionality, durability and costs not only depend on the type of the polymeric material used, but also on many other factors related to product design, processing and production.

The objectives of this Subtask are:

- To identify appropriate products for existing commercial and novel polymeric materials with high potential (short-, mid-, and long-term) which fulfill sustainability, durability and performance requirements criteria.
- To develop, investigate and establish structure/property-correlation for both, functional polymeric materials and polymer surfaces for solar thermal applications as well as performance defined structural polymeric materials for solar thermal applications.
- To evaluate polymer processing methods for the prototype production and cost-efficient mass production for solar thermal components.

Activities

- Providing information like specific property profiles of plastic materials, design approaches and processing routes to Subtasks A and B.
- Definition of parts and components of solar thermal systems to develop and investigate polymeric materials for (together with Subtasks A and B).
- Screening and evaluation of commercially available functional and structural materials for solar thermal applications.
- Formulation and preparation of novel functional and structural polymeric materials for solar thermal applications.
- Development and implementation of advanced characterization and test concepts and methods for assessment of the performance and durability that reflect the application and service relevant properties of polymeric materials in solar thermal applications.
- Investigation of the behavior of polymeric materials under service relevant loading and environmental conditions.
- Establishment of micro-structure/property/performance relationships and systematic further development and optimization of material formulations for solar thermal systems.
- Design and layout of polymeric components in solar thermal systems.
- Development and manufacturing of prototypes.

- Screening and evaluation of processing routes allowing for the mass-production of polymeric components in solar thermal systems.

Subtask C requires input from Subtasks A and B in terms of components to be developed and requirements to be fulfilled. Vice versa input to Subtasks A and B will be given to the specific properties and processing routes of plastics which are due to the macromolecular structure of polymers very different to inorganic materials, such as metal, ceramic or glass (e.g., time/temperature dependent behavior; functional properties; plastics processing).

According to the objectives the work will be carried out in the following three projects:

C1: Functional Polymeric Materials and Polymer Surfaces for Solar Thermal Applications
C2: Performance Defined Structural Polymeric Materials for Solar Thermal Applications
C3: Components and Polymer Processing

Duration

The Task was initiated on October 1, 2006 and will be completed on September 30, 2010.

ACTIVITIES DURING 2008

Standards, Regulations and Guidelines

An increase of the confidence of (conventional) solar thermal applications producers in polymeric materials is essentially during development phase of new products. Independent testing can help to overcome this lack of trust and create more confidence in the product. The huge variety of materials and test methods in different stages of process phases makes it very complicated for collector producers/developers to decide what is possible and necessary to test. One single standard test procedure for lifetime prediction in solar thermal applications is not possible. An overview over national/international standards was drafted.

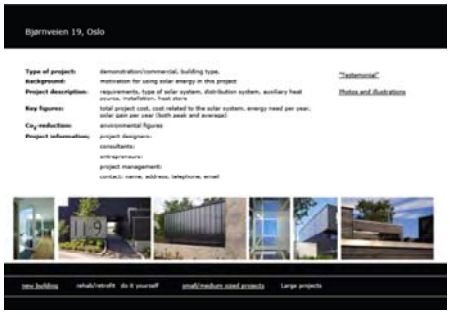
Taskforce "How to Make Solar Thermal Systems More Desirable"

The motivation for this taskforce is that the today's impression of solar thermal systems suffer a bit from low-tech/low status image – technically complicated but low-tech. The proposal for new definitions could be:

Solar thermal is a high-tech renewable energy with great performance! The core element of a solar thermal installation is solar collectors that convert the energy in sunlight directly into usable heat. These collectors can be aesthetically integrated with the building envelope or they can be mounted onto a building. Solar collectors are suitable for practically every type of south-facing roof or façade. Solar thermal installations have high-energy capacity, and end users therefore benefit of an attractive pay back on their investment. The systems are sophisticated, but very user friendly. Solar thermal is worldwide the second largest technology (after wind) considering renewable energy resources, and its importance within the global energy system will continue to increase in the future.

Sales arguments are:

- Independence, makes you less dependent on the big market actors (electricity, oil, gas), because you produce most of the energy you use yourself.
- Decentralized solutions, already distributed Zero-energy houses with solar; no CO_2-emission from my house.
- Biggest demand in your house should be covered by green production.
- No more use of oil or gas for heating my house.
- Control over my costs.
- Easy to use - it's plug and play.
- Keep the energy production within the country - don't be dependent on other countries' goodwill.
- Adds value to your house.
- Makes it easier to sell (maybe also easier to rent) - larger projects/multi family houses.



Dissemination and Information

A Glossary on 'solar thermal' and 'polymeric material' terms was prepared, reviewed and is now available on the public Task 39 website http://www.iea-shc.org/task39/glossary.htm.

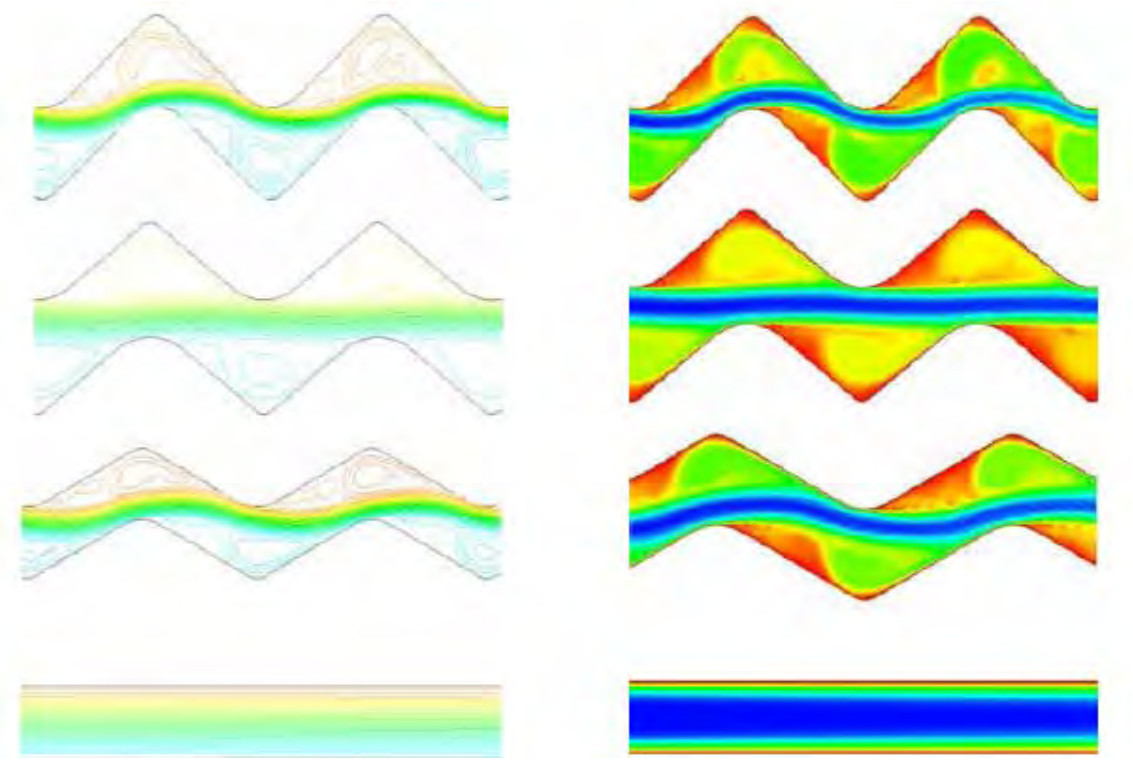
The experts agreed to distribute an electronic newsletter, which has been prepared from the presentations of Task 39 experts after every experts meeting. The newsletters are distributed to the Task participants, different contact lists and can be downloaded from the public Task 39 website http://www.iea-shc.org/task39/newsletters/index.html

Eleven Task 39-related presentations were given at the EuroSun 2008 (Lisbon, Portugal October 7-11, 2008). The abstracts can be found in the public website (www.iea-shc.org).

Subtask B: Solar Thermal Collectors

The following actions for developing polymeric collectors are going on:

- Production of polymer collectors by Soehner GmbH, Germany.
- Optimisation of the absorber geometry by CFD simulations in HTCO GmbH and Fraunhofer ISE, Germany.
- Pilot development of an all-polymeric collector at Aventa AS, Norway
- Collector-design at FH Ingolstadt, Germany, at INES, France, at SPF, Switzerland
- Over-heat protection by system design by Solartwin, UK
- Greenhouse collectors at Prirev, Portugal



CFD-simulation of different absorber channel designs Streamlines for liquid heat-transfer-media are shown in the left column, temperature distribution on the right side (brown color shows hot and blue colors cold regions).

Preliminary results about ongoing research and production projects are in discussion and the interaction may include:

- Material
  - glazing: PMMA, PC, Combination of both
  - absorber: PPS, PP, PEX, HD-PE, PVDF, PA12
  - The market for high temp. polymer materials may lead to faster decreasing prices (compared to metals)

- Processing
  - co extruding, twin sheets, welding, gluing
  - multi-functional extrusion. all possible advantages have to be made use of additional functionalities of components, aim is to take the labor out

- Functionality
  - flexibility system /building integration
  - Water instead of anti-freeze saves system costs.
  - End-caps have to take the forces with regard to collector connections. INES suggestion for clip-connectors: left hand side in the sketch should not stick out, if the right hand side sticks out, it is protected by longitudinal clip.

- Cost reduction
  - recycling material
  - Cost reduction by rain-tight collector fields for in-roof installation

- System requirements
  - low pressure systems

Subtask C: Materials

Functional Polymeric Materials and Polymer Surfaces for Solar Thermal Applications
In addition to the already delivered market review on thermotropic materials for overheating protection of solar-thermal collectors the topic modeling of thermotropic materials was considered. As a main result it was shown that, considering size distribution of domains, absorptions and calculating the behavior of layered systems, the optimal mean particle radius of the dispersed component should range from 100 to 200 nm. Furthermore, recent results on the development of thermotropic materials within this task were presented and discussed. While the research work on the Polymer Competence Center Leoben (PCCL) focuses on UV-curable resins with fixed domains, the company partner EMS Chemie AG develops impact modified polyamide grades. In both cases, the domain size of the thermotropic materials developed so far has to be further optimized (reduced).

Besides thermotropic materials for overheating protection, special attention is given to polymeric absorber coatings with spectrally selective properties. In 2008 a comprehensive state-of-the-art review was given by Prof. Orel and his co-workers from the National Institute of Chemistry (NIC, Ljubljana, Slovenia). Furthermore, novel coating formulations with advanced surface properties (e.g., easy-to-clean and antisoiling properties) were developed and characterized. In addition to the relevant functional properties the aging behavior was evaluated by accelerated lab tests. A proposal for a collaborative research project between NIC and the University of Oslo was prepared, submitted and approved by the EC (Funding program: MateraNet). The main objective of this project is to investigate the applicability and adhesion of novel absorber coatings on relevant polymeric substrates.

Performance Defined Structural Polymeric Materials for Solar Thermal Applications
In Subtask C2 an overview of commercial structural polymeric materials and relevant thermal transitions was provided by PCCL. Furthermore, the aging investigations on commodity and engineering polymers for black solar absorber applications in Northern climates (stagnation condition: air at 140°C for 500h, operating condition: water at 80°C for 16000h) were carried on. While PCCL provided aging data on specimen level, the aging behavior on component level was investigated by the University of Oslo. In both cases relevant degradation was detected for the currently used PPO+PS grade. Furthermore, different lifetime prediction models were used to provide long-term service conditions in air and water environment. In contrast to the investigated engineering polymer grades PPO+PS and polycarbonate (PC), a commodity polymer grade (i.e., polypropylene (PP)) exhibited a better long-term stability.

SPF Rapperswil provided a comprehensive investigation on the ageing behavior of commercially available polymeric glazing materials under outdoor exposure conditions. As a highlight of the ageing investigations it should be emphasized, that within the investigated exposure times (up to 20 years) an excellent stability was obtained for UV stabilized PMMA

grades. Such grades are commonly used as UV screening layers for the protection of polymeric substrates with less long-term weathering stability (e.g. polycarbonates in twin wall sheets).

At the University of Kassel an experimental set-up for the investigation of the changes of the water vapor transmission in structural polymers was developed. Furthermore, focus was given to the development of flexible liner materials for water storages. Novel formulations with improved thermal stability (target: long-term stability at 95°C) were prepared by the company partners APC, AGRU and Borealis. For these grades, the aging behavior will be characterized on specimen and component level by accelerated tests at elevated temperatures.

Components and Polymer Processing

Aventa succeeded in getting the pilot production of twin-wall sheet absorbers based on polyphenylenesulfide (PPS) started at Kaysersberg in France.

Extrusion of the Twin-wall sheet for the Aventa absorber.

AGRU started the production of a three-layer liner (with barrier-layer) with long-term stability at 80°C in air or water. This liner was installed in a seasonal thermal energy store in Eggenstein, Germany.

Polymeric liner installed in a seasonal thermal energy store (Eggenstein, Germany).

REPORTS AND PAPERS PUBLISHED IN 2008

Task 39 related presentations, posters, papers in conference proceedings:

- EuroSun 2008 (Lisbon, Portugal, October 7-11, 2008),
- Solar Thermal Industry Forum (before Intersolar 2008, ICM Munich, Germany, June 11, 2008)
- OTTI Symposium Thermische Solarenergie (Kloster Banz, Germany, April 23-25, 2008)
- Symposium Polymeric Solar Materials, (Leoben, Austria, February 7-8, 2008)

Ochs, F., Koch, H., Heidemann, W., Müller-Steinhagen, H.: Solar assisted district heating system with seasonal thermal energy storage in Eggenstein-Leopoldshafen, EuroSun Congress 2008, Lisbon, October 7-10, 2008, Portugal

Jack, S., Köhl, M., Müller, A., Weiss, K.-A.: Optimisation of polymeric solar thermal collectors by fluid dynamic simulations, EuroSun Congress 2008, Lisbon, October 7-10, 2008, Portugal

Nunes, C: .Novel solar absorber surfaces with organic pigments
EuroSun Congress 2008, Lisbon, October 7-10, 2008, Portugal

Meir, M., Gjessing, J., Rekstad, J., Rumler, N.: Overheating protection of polymeric solar collectors by triggered ventilation, EUROSUN Congress 2008, Lisbon, October 7-10, 2008, Portugal

Resch, K., Hausner, R., Wallner, G.M.: Modeling of an All Polymeric Flat-Plate Collector with Thermotropic Overheating Protection, EuroSun Congress 2008, Lisbon, October 7-10, 2008, Portugal

Resch, K., Wallner, G.M.,: Thermotropic materials for overheating protection of solar collectors
EuroSun Congress 2008, Lisbon, October 7-10, 2008, Portugal

Resch, K., Fischer, J., Weber, A., Wallner, G.M.: Overheating protection with thermotropic resin systems: Effect of material structure and morphology on light-shielding efficiency, EuroSun Congress 2008, Lisbon, October 7-10, 2008, Portugal

Ruesch, F., Brunold, S., Ageing Performance of Collector Glazing Materials - Results from 20 Years of Outdoor Weathering, EuroSun Congress 2008, Lisbon, October 7-10, 2008, Portugal

Godinho, L.H., Graça, M.P.F: .Solar Thermal Collection, Storage and Distribution of Solar Heat in Greenhouses, EuroSun Congress 2008, October 7-10, 2008, Lisbon, Portugal

Johnston, B., Sharp, S.: The Zero Carbon Solar Thermal Solar Powered Controller, EuroSun Congress 2008, October 7-10, 2008, Lisbon, Portugal

Meir, M., Buchinger, J., Kahlen, S., Köhl, M., Papillon, P., Rekstad, J., Wallner, G.M., Polymeric solar collectors - State of the Art, EuroSun Congress 2008, October 7-10, 2008, Lisbon, Portugal

Rekstad, J. :"All polymer" solar collectors for medium temperature applications, 1st Solar Thermal Industry Forum, June 11, 2008, ICM Munich, Germany

Ochs, F.: Large scale seasonal thermal energy stores, 1st Solar Thermal Industry Forum, June 11, 2008, ICM Munich, Germany

Michael Köhl, Hannes Franke, Eva Stricker, Karl-Anders Weiß: Solarthermische Kollektoren auf Polymerbasis – Eine Machbarkeitsuntersuchung, 18. OTTI Symposium Thermische Solarenergie, April 23-25, 2008, Kloster Banz, Germany

Nitz, P., Wilson, H.R.: Modellierung thermotroper Materialien, Symposium Polymeric Solar Materials, February 7-8, 2008, Congress Leoben, Austria

Bohmayr, W.: Herstellung und Anwendung von Kunststoffdichtungsbahnen, Symposium Polymeric Solar Materials, February 7-8, 2008, Congress Leoben, Austria

Hausner, R.: Modellierung von Kunststoffkollektoren mit Überhitzungsschutz, Symposium Polymeric Solar Materials, February 7-8, 2008, Congress Leoben, Austria

Kahlen, S.: Alterungsverhalten von polymeren Absorbermaterialien, Symposium Polymeric Solar Materials, February 7-8, 2008, Congress Leoben, Austria

Leibfried, U.: Erfolgreiche Lösungen für Kunststoffe in Solarsystemen, Symposium Polymeric Solar Materials, February 7-8, 2008, Congress Leoben, Austria

Müller, A.: Modellierung von Wärmetauschern aus Kunststoff, Symposium Polymeric Solar Materials, February 7-8, 2008, Congress Leoben, Austria

Resch, K.: Entwicklung thermotroper Materialien, Symposium Polymeric Solar Materials, February 7-8, 2008, Congress Leoben, Austria

Rytka, C.: Spezialpolyamide für die Solartechnik, Symposium Polymeric Solar Materials, February 7-8, 2008, Congress Leoben, Austria

Saphörster, M., Kunststoffe in solarthermischen Kollektoren - Erfahrungen aus Sicht der Bosch Thermotechnik, Symposium Polymeric Solar Materials, February 7-8, 2008, Congress Leoben, Austria

Wilhelms, C.: Modular aufgebauter Warmwasserspeicher, Symposium Polymeric Solar Materials, February 7-8, 2008, Congress Leoben, Austria

Ochs, F., Saisonale Wärmespeicherung – Eine Herausforderung für Polymere Symposium Polymeric Solar Materials, February 7-8, 2008, Congress Leoben, Austria

Meir, M.: IEA-SHC Task 39: Kunststoffkollektoren – State of the Art, Symposium Polymeric Solar Materials, February 7-8, 2008, Congress Leoben, Austria

Task 39 in the Press

Are Plastics the Material ff the Future?
Jens–Peter Meyer, Sun Wind & Energy 1/2009, BVA Bielefelder Verlag, pp. 62-67.

"Cooperation with polymer processing companies is very important"; Michael Köhl interviewed by Jens–Peter Meyer, Sun Wind & Energy 1/2009, BVA Bielefelder Verlag, pp. 66-67.

Kollektoren aus Kunststoff: Unbegrenzte Spielwiese; Jens–Peter Meyer, , Sonne Wind & Wärme 1/2009, BVA Bielefelder Verlag, pp. 80-83.

"Wir brauchen die Zusammenarbeit mit Polymerverarbeitern"; Michael Köhl interviewed by Jens–Peter Meyer, Sonne Wind & Wärme 1/2009, BVA Bielefelder Verlag, pp. 82-83.

Solar thermal in Europe: Expanding markets, better political framework conditions and state-of-the-art technical solutions: Polymers instead of expensive metals: plastics for solar collectors; Rolf Hug, The Solarserver, Forum for Solar Energy, May 22, 2007
http://www.solarserver.de/solarmagazin/solar-report_0507_e.html

MEETINGS IN 2008

4th Experts Meeting
April 28-30
Oslo, Norway

5th Experts Meeting
October 13-15
Lisbon, Portugal

MEETINGS PLANNED FOR 2009

6th Experts Meeting
April, 27-29
Rapperswil, Switzerland

7th Experts Meeting
October 21-23
Golden, CO, USA or Chester, UK

TASK 39 NATIONAL CONTACTS

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TASK 40/ANNEX 52: TOWARDS NET ZERO ENERGY SOLAR BUILDINGS

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TASK DESCRIPTION

The objective of the Task is to study current net-zero, near net-zero and very low energy buildings and to develop a common understanding, a harmonized international definitions framework, tools, innovative solutions and industry guidelines. A primary means of achieving this objective is to document and propose practical NZEB demonstration projects, with convincing architectural quality. These exemplars and the supporting sourcebook, guidelines and tools are viewed as keys to industry adoption. These projects aim to equalize their small annual energy needs, cost-effectively, through building integrated heating/cooling systems, power generation and interactions with utilities.

The Task will build upon recent industry experiences with net-zero and low energy solar buildings and the most recent developments in whole building integrated design and operation. The joint international research and demonstration activity will address concerns of comparability of performance calculations between building types and communities for different climates in participating countries. The goal is solution sets that are attractive for broad industry adoption.

The scope includes major building types (residential and non-residential), new and existing, for the climatic zones represented by the participating countries. The work will be linked to national activities and will focus on individual buildings, clusters of buildings and small settlements. The work will be based on analysis of existing examples that leads to the development innovative solutions to be incorporated into national demonstration buildings.

The objectives shall be achieved in the following Subtasks:

Subtask A: Definitions & Large-Scale Implications
(Germany: Karsten Voss)
Subtask B: Design Process Tools and Simulation
(USA: Paul Torcellini, Canada: Andreas Athienitis)
Subtask C: Advanced Building Design, Technologies and Engineering
(NZ: Michael Donn, France: François Garde)
Subtask D: Dissemination
(All Subtask Leaders)

Subtask A: Definitions & Large-Scale Implications

The objective of this Subtask (STA) is to establish an internationally agreed understanding on NZEBs based on a common methodology. The Participants shall achieve this objective by the following activities:

- The review and analysis of existing NZEB definitions and data (site/source energy, emissions, exergy, costs, etc.) with respect to the demand and the supply side;

- A study of grid interaction (power/heating/cooling) and time dependent energy mismatch analysis.
- The development of a harmonized international definition framework for the NZEB concept considering large-scale implications, exergy and credits for grid interaction (power/heating/cooling).
- The development of a monitoring, verification and compliance guide for checking the annual balance in practice (energy, emissions and costs) harmonized with the definition.

Subtask B: Design Process Tools

The Subtask (STB) aims to identify and refine design approaches and tools to support industry adoption. The Participants shall achieve this objective by the following activities:

- Documenting processes and tools currently being used to design NZEBs and under development by participating countries.
- Assessing gaps, needs and problems, considering the work of STA and STC, and inform simulation engine and detailed design tools developers of priorities for NZEBs.
- The development and testing of design approaches and simplified NZEB tools or interfaces (e.g. spreadsheet or web-based method) linked to STC Solution Sets to support integration of NZEB technologies and architecture at the early design stage.

Subtask C: Advanced Building Design, Technologies and Engineering

The objectives of this Subtask (STC) are: to develop and test innovative, whole building net-zero solution sets for cold, moderate and hot climates with exemplary architecture and technologies that would be the basis for demonstration projects and international collaboration. The Participants shall achieve these objectives by the following activities:

- Documenting and analyzing current NZEBs designs and technologies, benchmarking with near NZEBs and other very low energy buildings (new and existing), for cold, moderate and hot climates considering sustainability, economy and future prospects using a projects database, literature review and practitioner input (workshops).
- Developing and assessing case studies and demonstration projects in close cooperation with practitioners.
- Investigating advanced integrated design concepts and technologies in support of the case studies, demonstration projects and solution sets .
- Developing NZEB solution sets and guidelines with respect to building types and climate and to document design options in terms of market application and CO2 implications.

Subtask D: Dissemination

The objective of the dissemination activity is to support knowledge transfer and market adoption of NZEBs on a national and international level. Subtask leaders will be responsible for the coordination of the individual contributions of Subtask participants and for coordination with the other Subtasks where a combined output is planned. The Participants shall achieve the objectives by the following activities:

- Establishing an NZEB web page, within the IEA SHC/ECBCS Programmes' framework, and a database that can be expanded and updated with the latest projects and experiences.
- Producing a NZEB source book including example buildings for investigated building types and climates.

- Transferring the Task outputs to national policy groups, industry associations, utilities, academia and funding programs.
- Establishing an education network, summer school and contributions to the Solar Decathlon and similar student activities.
- Workshops, articles and features in magazines to stimulate market adoption.

Duration

This Task was initiated on October 1, 2008 and remains in force until September 30, 2013.

ACTIVITIES DURING 2008

This is a new Task that started in October 2008. Two planning meeting were held as well as the preparation and approval of the Task Proposal. A website: http://iea-shc.org/task40 has also been established.

ACTIVITIES PLANNED FOR 2009

Key activities planned for 2009 include:

- Completion of the detailed work for each Subtask.
- Preparation and approval of national team participation letters.
- Gathering of background and baseline data on existing NZEB buildings, the establishment of a database and analysis of this information.
- Formation of Subtask Working Groups
- Two Industry Workshops in conjunction with the Experts meetings (Canada and Germany)

REPORTS PUBLISHED IN 2008

A Joint Task Proposal: Towards Net Zero Energy Solar Buildings, was prepared and approved by the SHC and ECBCS Executive Committees. It is available at: http://iea-shc.org/publications/task.aspx?Task=40

MEETINGS IN 2008

1st Planning Meeting
January 24-25
Washington, USA

2nd Planning Meeting
October 6-7
Lisbon, Portugal

MEETINGS PLANNED FOR 2009

1st Experts Meeting
May 6-8
Montreal, Canada

2nd Experts Meeting
5-7 October
Germany

TASK 40/ANNEX 52 NATIONAL CONTACTS

A "start-up" phase is being conducted from October 1st, 2008 to April 30th, 2009. This "start-up" phase is focused on the preparation of detailed work plans for each Subtask and the provision of time to establish national teams and secure funding for participation in the Task. Therefore, not all the national team contacts have been confirmed at this time and some of those listed below are subject to change.

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The following is a list of interested countries. Participation will be confirmed by the signing of National Letters of Participations. Please go to the Task page on the SHC web site for updates: http://www.iea-shc.org/task40/index.html

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Belgium
Brazil (observer)
Canada
Denmark
Finland
France
Germany
Italy
Netherlands
New Zealand
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Poland
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SHC Projects & Lead Countries

Task 1	Performance of Solar Heating and Cooling Systems, 1977-83 (Denmark)
Task 2	National Solar R & D Programs & Projects, 1977-84 (Japan)
Task 3	Solar Collector and System Testing, 1977-87 (Germany and United Kingdom)
Task 4	Insolation Handbook and Instrumentation Package, 1977-80 (United States)
Task 5	Existing Meteorological Information for Solar Applications, 1977-82 (Sweden)
Task 6	Evacuated Tubular Collector Performance, 1979-87 (United States)
Task 7	Central Solar Heating Plants with Seasonal Storage, 1979-89 (Sweden)
Task 8	Passive Solar Low Energy Homes, 1982-89 (United States)
Task 9	Solar Radiation and Pyranometry, 1982-91 (Canada and Germany)
Task 10	Solar Materials R & D, 1985-91 (Japan)
Task 11	Passive Solar Commercial Buildings, 1986-91 (Switzerland)
Task 12	Solar Building Analysis Tools, 1989-94 (United States)
Task 13	Advanced Solar Low Energy Buildings, 1989-94 (Norway)
Task 14	Advanced Active Solar Systems, 1990-94 (Canada)
Task 15	Advanced Central Solar Heating Plants, not initiated
Task 16	Photovoltaics for Buildings, 1990-95 (Germany)
Task 17	Measuring and Modeling Spectral Radiation, 1991-94 (Germany)
Task 18	Advanced Glazing Materials, 1991-97 (United Kingdom)
Task 19	Solar Air Systems, 1993-99 (Switzerland)
Task 20	Solar Energy in Building Renovation, 1993-98 (Sweden)
Task 21	Daylight in Buildings, 1995-99 (Denmark)
Task 22	Building Energy Analysis Tools, 1996-00 (United States)
Task 23	Optimization of Solar Energy Use in Large Buildings, 1997-02 (Norway)
Task 24	Solar Procurement, 1998-03 (Sweden)
Task 25	Solar Assisted Air Conditioning of Buildings, 1999-04 (Germany)
Task 26	Solar Combisystems, 1998-02 (Austria)
Task 27	Performance of Solar Facade Components, 2000-05 (Germany)
Task 28	Solar Sustainable Housing, 2000-05 (Switzerland)
Task 29	Solar Crop Drying, 2000-06 (Canada)
Task 30	Solar Cities, not initiated
Task 31	Daylighting Buildings in the 21st Century, 2001-05 (Australia)
Task 32	Advanced Storage Concepts for Solar and Low Energy Buildings, 2003-07 (Switzerland)
Task 33	Solar Heat for Industrial Processes, 2003-07 (Austria)
Task 34	Testing and Validation of Building Energy Simulation Tools, 2003-07 (United States)
Task 35	PV/Thermal Systems, 2005-07 (Denmark)
Task 36	Solar Resource Knowledge Management, 2005-10 (United States)
Task 37	Advanced Housing Renovation with Solar & Conservation, 2006-09 (Norway)
Task 38	Solar Air Conditioning and Refrigeration, 2006-09 (Germany)
Task 39	Polymeric Materials for Solar Thermal Applications, 2006-10 (Germany)
Task 40	Towards Net Zero Energy Solar Buildings, 2008-13 (Canada)
Task 41	Solar Energy and Architecture, 2009-12 (Denmark, Norway, Sweden)
Task 42	Compact Thermal Energy Storage, 2009-12 (Netherlands)
Task 43	Rating and Certification Procedures – Advanced Solar Thermal Testing and Characterization for Certification of Collectors and Systems, 2009-12 (TBD)