



TASK 49

SOLAR PROCESS HEAT FOR PRODUCTION AND ADVANCED APPLICATIONS

ANNEX

OCTOBER 2011

**This Annex text was prepared by Christoph Brunner of AEE INTEC,
Austria**

Annex 49

Solar Process Heat for Production and Advanced Applications

1. Definitions

(a) *Description of Technical Sector*

The industrial sector accounts for approximately 30% of the energy consumption in the OECD countries. The major share of the energy which is needed in trade and industrial companies for production processes and for heating production halls is below 400°C.

To be able to make use of the huge potential for solar heat in the industry and to open a new market sector for the solar thermal industry, it is necessary to integrate solar thermal systems into the industrial processes in a suitable way. Especially it is necessary to further develop the solar thermal components so that they fulfil the requirements stipulated.

(b) *Definitions*

The scopes of the Task is on solar thermal technologies for converting the solar radiation into heat and further the intelligent integration of the produced heat into industrial processes (i.e., the subject which is covered by the Task starts with the solar radiation reaching the collector and ends with the hot air, water or steam being integrated into the application).

Applications, systems and technologies, which are included in the scope of this task, are:

- All industrial processes which are thermal driven and running in a temperature range up to 400°C.
- Solar thermal systems using air, water, low pressure steam or oil as a heat carrier, i.e. not limited to a certain heat transfer medium in the solar loop.
- All types of solar thermal collectors for an operating temperature level up to 400°C are addressed: uncovered collectors, flat-plate collectors, improved flat-plate collectors - for example hermetically sealed collectors with inert gas fillings, evacuated tube collectors with and without reflectors, CPC collectors, MaReCos (Maximum Reflector Collectors), parabolic trough collectors.
- Technologies for industrial application that can be driven by sunlight or specific spectrums (e.g. UV).

Specific process engineering technologies to which solar heat has to be supplied, such as the technologies for desalination of seawater, industrial cooling applications and electricity generation, are not the main focus of the Task. They may be considered to a certain extent if there is strong interest from industry.

For cooling applications, for instance, the work will be restricted to the adaptation of the results of SHC Task 38 to industrial applications.

The foreseen activities in the field of heat storage management will not deal with the development of storage technologies and the application of new storage materials. This work will be addressed in the IEA SHC Task 42 and its follow up activities. There is a link of this IEA SHC Task to the activities in IEA SHC Task 45 “Large scale systems” due to the size of the solar thermal systems and the challenges faced by both applications. The main differences of SHC Task 49 from the IEA SHC Task 45 can be seen in:

- Close interlink age between solar thermal system and industrial processes
- Combination of process intensification and solar thermal systems
- Dealing with new applications
- Different temperature levels (SHIP up to 400°C) and more relevance on the development and application of concentrated systems
- Based on the higher temperatures different challenges on material, fluids, collector and components behaviour are considered
- Different stagnation behaviour due to batch processes and different hot storage management
- Detailed focus on industrial processes in combination with solar thermal collectors

To conduct this work the SHC Implementing Agreement will collaborate with the IEA SolarPACES Implementing Agreement at a ‘Maximum Level of Collaboration’, as outlined in the SHC Implementing Agreement’s Policy on Collaboration

2. Purpose and Objectives

The content of this new proposed project was defined based on knowledge from SHC 33/SolarPACES Task IV and opposition papers, such the strategic research agenda of the European Solar Thermal Technology Platform and the experience of several national projects in the field of solar process heat.

The main goals of the activity will be to:

Process Heat Collectors:

- Improve solar process heat collectors and collector loop components.
- Provide a basis for the comparison of collectors with respect to technical and economical conditions.
- Give comprehensive recommendations for standardized testing procedures

Process Integration and Process Intensification Combined with Solar Process Heat:

- Improve solar thermal system integration for production processes by advanced heat integration and storage management, advanced methodology for decision on integration place and integration types.
- Increase the solar process heat potential by combining process intensification and solar thermal systems and fostering new applications for solar (thermal/UV) technologies.

Design Guidelines, Case Studies and Dissemination:

- Provide a worldwide overview of results and experiences from solar heat for industrial process systems(including completed and ongoing demonstration system installations using monitoring data, as well as carrying out economic analyses) in order to lower the barriers for market deployment and to disseminate the knowledge to the main target groups involved.

- Develop a performance assessment methodology for a comparison and analysis of different applications, collector systems, regional and climatic conditions.
- Support future project stakeholders by providing design guidelines, simplified fast and easy to handle calculation tools for solar yields and performance assessment.
- Investigate system solutions for stagnations behaviour, control and hydraulics of large field installations.

3. Activities

(a) Main activities

- Process heat collector development and process heat collector testing
- Process integration and Process Intensification combined with solar process heat
- Design Guidelines, Case Studies and Dissemination

(b) Sub-activities

The activities will be performed in 3 subtasks:

Subtask A: Process heat collector development and process heat collector testing

- A1. Improvement of solar process heat collectors and collector loop components
 - Design and define general requirements and relevant parameters for process heat collectors and their improvement
 - Define high temperature behaviour of process heat collectors and solar loop components
 - Improve process heat collectors and solar loop components
- A2. Comparison of collectors with respect to technical and economical conditions
- A3. Comprehensive recommendations for standardized testing procedures
 - Provide a basis for the standardized comparison of collectors under certain conditions
 - Provide recommendations for testing procedures

Subtask B: Process integration and Process Intensification combined with solar process heat

- B1: Develop advanced pinch and storage management tool(s)
- B2: Survey integration methodologies for solar process heat
- B3: Develop system concepts and integration guideline
- B4: Survey and hold dedicated workshop on new process technologies
- B5: Identify the increasing potentials and compendium of ongoing activities and existing pilot plants/case studies

Subtask C: Design Guidelines, Case Studies and Dissemination

- C1. Design Guidelines
 - Develop Design Guidelines for integration of solar thermal systems in industrial processes

- C2: Numerical Simulation Tools
 - Further develop and adapt numerical simulation tools for the improved design of solar thermal systems
- C3: Conduct performance assessment methodology for process heat collector types in different industrial application scenarios
- C4: Monitor demonstration projects and “Best practice” projects
- C5: Disseminate task results
- C6: Market deployment
- C7: Potential study

(c) *Workshops and Seminars*

Industry workshops will be held in conjunction with every Task meeting. The workshops will be organised in the host country of the meeting and all relevant target groups will be invited.

National industry workshops will be organised by Task participants using the information gathered during Task workshops and the material produced by the Task. These will be performed once a year

Start missions: There is a recognized need to process information from worldwide stakeholders outside the Task, and to start educational missions to relevant countries in the developing and developed world.

(d) *Publications/Newsletters*

The overall scope and objectives of the Task and the different Subtasks will be described on the Task Website. In addition to the publication of scientific results in conferences, journals and magazines, printed leaflets will be distributed to describe the scope of the Task.

4. Expected Results/Deliverables

The deliverables, allocated to the 3 subtasks, will be:

Subtask A: Process heat collector development and process heat collector testing

A1. Improvement of solar process heat collectors and collector loop components:

- A1-1 Definition of general requirements and relevant parameters for process heat collectors (and specific collector loop components) and their improvement [SPF, University of Balears, CENER, DLR, ISE, AIT, Industrial Solar, AEE INTEC]
- A1-2 Report on overheating/stagnation issues including the high temperature behavior of the investigated components [SPF, AIT, AEE INTEC, ISFH]
- A1-3 Brochure on State of the Art of process heat collectors [SPF, all]

A2. Comparison of collectors with respect to technical and economical conditions:

- A2-1 An overview of collector output and key figures for defined conditions [ISE, SPF, University of Balleares, CENER, Industrial Solar, DLR, etc.]
- A3. Comprehensive recommendations for standardized testing procedures:
- A3-1 Recommendations for different kind of test procedures, reports and test rig configurations [CENER, SPF, CIEMAT, ITW, ISE, AIT, DLR], e.g.:
 - a. Sub components (tracking, receiver, mirrors, glasses, etc.)
 - b. Collector laboratory tests
 - c. Collector field tests
 - d. Service lifetime test procedures for collector components of medium temperature collectors.
- A4. Subtask report

Subtask B: Process integration and Process Intensification combined with solar process heat

- B1. Advanced pinch and storage management tool
- B2. Integration guideline (methodology for advanced integration, system concepts, guidelines on integration types, checklists etc.)
- B3. Extended matrix of indicators (<http://wiki.zero-emissions.at>)
- B4. Catalogue of additional required components for advanced integration
- B5. Report on potential for enhancement of solar integration with new process technologies (based on (existing) case studies)
- B6. General booklet of Subtask B
- B7. Subtask report

Subtask C: Design Guidelines, Case Studies and Dissemination

- C1: Publication of Design guidelines for solar industrial process heat systems
- C2: Overview and description of simulation tools for solar industrial process heat components
- C3: Report on Performance assessment methodology and simulation case studies
- C4: “Best practice” series of case study reports from demonstration projects
- C5: Potential study solar process heat worldwide
- C6: Subtask report

5. Rights and Obligations of Participants

In addition to the obligations enumerated in Article 4 of the Implementing Agreement:

- (a) Each participating institution/company shall provide the Operating Agent with detailed reports on the results of the work carried out for each Subtask;
- (b) Each participating institution/company shall collect, assess and report to the Operating Agent data on solar heating systems for industrial applications in his country; and
- (c) Each participating institution/company shall participate in the editing and reviewing of draft reports of the Task and Subtasks.
- (d) *Operating Agent Meetings*
Each country will bear the costs of its own participation in the Task, including necessary travel costs. The cost of organising meetings will be borne by the host country.
- (e) *Individual Financial Obligations*

Aside from providing the resources required for performing the work of the Subtasks in which they are participating, all Participants are required to commit the resources necessary for activities which are specifically collaborative in nature and which would not be part of activities funded by national or international sources. Examples include the preparation for and participation in Task meetings, co-ordination with Subtask Participants, contribution to the documentation and dissemination work and Task related R&D work which exceeds the R&D work carried out in the framework of the national (or international) activity.

(f) *Task-Sharing Requirements*

The Participants agree on the following funding commitment:

- 1) Each Participant (country) will contribute to this Task a minimum of 1.26-person year per year of the Task, i.e. a total minimum of 5 person years. This means that each participating institution/company shall commit to the Task a minimum of 4-person -months per year of the Task.
- 2) Participation in the Task requires participation in at least one of the Subtasks.
- 3) The Operating Agent will contribute with a minimum of 0.33-person year per year to the Task (i.e., a total of 1.7 person years for his/her work as Operating Agent).
- 4) The Subtask leader shall commit a minimum of 3 person-month per year for the work.
- 5) Participation may partly involve funding already allocated to a national (or international) activity that is substantially in agreement with the scope of work outlined in this Annex. Aside from providing the resources required for performing the work of the Subtasks in which they are participating, all Participants are required to commit the resources necessary for activities that are specifically collaborative in nature and that would not be part of activities funded by national or international sources. Examples include the preparation for and participation in Task meetings, co-ordination with Subtask Participants, contribution to the documentation and dissemination work and Task related R&D work which exceeds the R&D work carried out in the framework of the national (or international) activity.

6. Management

(a) The Republic of Austria, acting through the AEE - Institute for Sustainable Technologies (AEE INTEC), is designated as Operating Agent.

(b) The Operating Agent's rights, obligations and responsibilities in addition to those indicated in the main body of the Implementing Agreement and the organisation of the work under this Annex enumerated in Section 5 of this Agreement, the Operating Agent shall:

- 1) Prepare and distribute the results mentioned in paragraph 4 above;
- 2) Prepare joint assessments of research, development and demonstration priorities for solar heating systems for industrial processes;
- 3) At the request of the Executive Committee, organise workshops, seminars, conferences and other meetings;
- 4) Prepare the detailed Program of Work for the Task in consultation with the Subtask Leaders and the Participants and submit the Program of Work

for approval to the Executive Committees of the Solar Heating and Cooling Programme and the SolarPACES Programme;

- 5) Propose and maintain a methodology and a format for the submission of information on solar heating systems for industrial processes which is collected by the Participants as described in paragraphs 3 and 4 above;
- 6) Provide reports semi-annually to the Executive Committees on the progress and the results of the work performed under the Programme of Work;
- 7) Provide to the Executive Committees, within six months after completion of all work under the Task, a final report for its approval and transmittal to the Agency;
- 8) In co-ordination with the Participants, use its best efforts to avoid duplication with activities of other related programmes and projects implemented by or under the auspices of the Agency or by other competent bodies;
- 9) Provide the Participants with the necessary guidelines for the work they carry out with minimum duplication;
- 10) Perform such additional services and actions as may be decided by the Executive Committees, acting by unanimity; and
- 11) Gather documents from Subtask Leaders, edit and distribute the output of the Task either as a printed handbook, electronically or on a Web site.
- 12) A Subtask Leader for each of the foregoing Subtasks will:
 - a. Co-ordinate the work performed under that Subtask;
 - b. Assist the Operating Agent in preparing the detailed Programme of Work;
 - c. Direct technical workshops and provide the Operating Agent with written summaries of workshops results and
 - d. Edit technical reports resulting from the Subtask and organise their publication.
 - e. Subtask leaders may arrange meetings in between or in association with Experts meetings of the Task.
- 13) The Subtask Leader shall be a Participant that provides to the Subtask a high level of expertise and undertakes substantial research and development in the field of the Subtask. The Subtask Leaders shall be proposed by the Operating Agent and designated by the Executive Committee, acting by unanimity of the Participants. Changes in the Subtask Leaders may be agreed to by the Executive Committee, acting by unanimity of the Participants.

(c) *Operating Agent's Meetings:* There will be Experts meetings of the Task at intervals of approximately 6 months. Subtask Leaders may arrange meetings in between or in association with Experts meetings of the Task. Attendance at the Experts Meetings of the Task will be mandatory.

(d) It is intended to organize expert / industry workshops every year, directly linked to Task meetings. The overall scope and objectives of the Task and the different Subtasks will be described on the Task Website. The server should be able to process an automatically distributed electronic newsletter.

Apart from publications of scientific results in conferences, journals and magazines we plan to distribute printed leaflets to describe the scope of the Task. Similarly, there is a recognized need to process information from worldwide stakeholders outside the Task, and to start educational missions to relevant countries in the developing and developed world.

7. Admission, Participation and Withdrawal of Participants

In addition to the specific obligations, the Operating Agent will produce, promote and distribute the results of the Task. The Participants will support these activities by contributing respective papers and by dissemination activities financed by the individual Participants.

8. Information and Intellectual Property

For purposes of this Annex, in case of conflict with the provisions of the Implementing Agreement, the following provisions shall prevail:

- a) For arising information regarding inventions the following rules shall apply:
 - 1) Arising information regarding inventions shall be owned in all countries by the inventing Participant. The inventing Participant shall promptly identify and report to the Executive Committee any such information along with an indication whether and in which countries the inventing Participant intends to file patent applications, and
 - 2) Information regarding inventions on which the inventing Participant intends to obtain a patent protection shall not be published or publicly disclosed by the Operating Agent or the other Participants until a patent has been filed, provided, however, that this restriction on publication or disclosure shall not extend beyond twelve months from the date of reporting of the invention. It shall be the responsibility of the inventing Participants to appropriately mark Task reports that disclose inventions that have not been appropriately protected by filing a patent application.
- (b) The inventing Participant shall license proprietary information arising from the Task for non-exclusive use as follows:
 - 1) To Participants in the Task:
 - a. On the most favourable terms and conditions for use by the participants in their own country; and
 - b. On favourable terms and conditions for the purpose of sub-licensing others for use in their own country.
 - 2) Subject to sub-paragraph above, to each participant in the Task for use in all countries, on reasonable terms and conditions; and
 - 3) To the government of any Agency Member country and nationals designated by it, for use in such country in order to meet its energy needs.

Royalties, if any, under licenses pursuant to this paragraph shall be the property of the inventing Participant.

9. Entry into Force, Term and Extension

This Annex shall enter into force on 1st February 2012 and shall remain in force for a period of 4 years/until 31st of January 2016. At the conclusion of that period, this Annex can be extended by at least two Participants, acting in the Executive Committee, for a period to be determined at that time, provided that in no event shall the Annex continue beyond the current term, or actual termination, of the Implementing Agreement.