



Task 56

Building Integrated Solar Envelope Systems for HVAC and Lighting

ANNEX

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Annex 56

Building Integrated Solar Envelope Systems for HVAC and Lighting

1. Scope

This Task will focus on the critical analysis, simulation, laboratory test and onsite monitoring of envelope systems entailing elements that use and/or control incident solar energy, having one or more of the following uses:

- To deliver renewable thermal or/and electric energy to the systems providing heating, cooling and ventilation to buildings
- To reduce heating and cooling demands of buildings, while controlling daylight

Technologies are considered that account for the specificity of the intervention on residential and tertiary buildings, both new-built and retrofitted.

Integration of Solar Envelope solutions into the building's HVAC and lighting systems through a systemic approach is central in this Task.

Energy performance, indoor comfort and architectural integration are addressed all along the Task duration.

In the residential sector, solar thermal and PV systems are typically mounted on building roofs with limited attempt to incorporate them into the building envelope, creating aesthetic drawbacks and space availability problems. On the contrary, the use of facades is highly unexplored. Daylight control is delegated to the individuals' management of blinds and curtains, leading to high thermal loads both during midseasons and summertime.

In the tertiary segment (offices, schools, hospitals), the roof is again, most of the time, the only surface devoted to the installation of solar thermal and PV technologies. While daylight control is now state of the art in terms of shading effect, the utilization of shading devices to also redirect natural light into the room, improving visual comfort at the same time, has still to be improved.

Moreover, when energy efficient technologies are installed together with traditional ones, frequently the first are just "added on top" of the main systems, thereby investment costs burst and performance are hardly optimised.

The Task will focus on solutions looking at the mass market through an industrialised integration of active components into envelope elements. This is believed to provide the lowest cost-to-benefit ratio by:

- Optimising the installation and maintenance costs

- Entailing optimised control and continuous monitoring
- Providing reliable operation and predictable performance
- Eventually ensuring that more than one function is covered among the ones stated above (multifunctional systems)
- Substituting part of the backup system, instead of adding functionalities
- Reducing primary energy use by optimising the yearly solar energy utilization.

Despite the focus on industrialised solutions, best practices in terms of customised solutions will be also analysed in an attempt to assess their performance and potential adoption on the market.

The strategic objective of the Task is to coordinate the research and innovation effort taking place within the scientific community and the private sector, towards the utilization of envelope integrated technologies.

2. Objectives

- To gather relevant information on market available and “under-development” solar envelope systems both in terms of performance and costs
- To assess and develop test methods for the performance characterization of solar envelope elements (thermal, electric and daylighting performance characterization)
- To assess and develop simulation models for the performance characterization of solar envelope elements (thermal, electric and daylighting performance characterization)
- To develop design, manufacturing and installation guidelines for industrialised solar envelope systems, accounting for technological, architectural/aesthetical, economic, financing and customer acceptance viewpoints
- To assess and develop business models for solar envelope systems
- To enhance awareness of the public and private sector on the treated technologies.

3. Activities

The main activities in Task 56 are grouped in the following Subtasks.

3.1 Subtask A: Solar envelope systems classification and communication

An overview of products and solutions of solar envelope systems, which are presently available on the market, will be made available in Subtask A as a preparatory work for Subtask B and C. In particular, the conditions for the effective deployment of solar envelope systems will be analysed in this Subtask.

In addition, the communication of such factors and of the overall results will be

tackled here.

A market analysis will be firstly carried out (Activity A.1) assessing existing solutions through a literature review and the advice of the experts participating. Moreover, standards, test methods and numerical tools will be categorised.

Different products and solutions will be evaluated through a SWOT analysis, accounting for technical and non-technical issues, which in the past have determined the success or the failure of solar envelope systems (Activity A.2). A major activity of Subtask A will be then to attract and involve central actors, decision makers, planners, builders, architects, experts from research and industry. This will be achieved by the exchange of information generated in all Subtasks through local workshops, newsletters and an updated public website (Activity A.3).

Activities description:

Activity A.1 – Market overview

Activity A.2 – SWOT analysis

Activity A.3 – Dissemination

3.2 Subtask B: Performance characterisation of solar envelope elements

Subtask B aims to develop tools and strategies to foster the market penetration for industrialised solar envelope systems. In particular, it focuses on the solar envelope elements intended as the sub-systems, strictly incorporated in the building envelope.

Solar envelope elements need to be integrated in the construction process already at an early planning stage. To this purpose, planners need to be provided with the necessary information – i.e. integration parameters, performance measurements and modelling, etc. – when starting their task. The target of the subtask is finally a successful construction process including the transfer of knowledge and models e.g. between the component manufacturers and the planners of the building.

Key here is therefore the involvement of an industrial partnership from the very beginning of the program. The Activities reported next will be elaborated only with reference to the specific elements suggested by the manufacturers involved in the Task.

This Subtask will be built on three main Activities:

- development of strategies for the effective market penetration of solar envelope systems developed by the Task partners
- elaboration of simulation models for solar envelope elements, developed by the Task partners
- development of laboratory tests requirements for performance and functional assessment of solar envelope elements.

Activities description:

Activity B.1 – Strategies for market penetration

Activity B.2 – Simulation models of solar envelope elements

Activity B.3 – Laboratory tests of solar envelope elements

3.3 Subtask C: Assessment of solar envelope systems at building level

In Subtask C complete solar envelope systems are defined based on active and passive components and integrated into the HVAC system of reference buildings. These buildings are considered as virtual case studies, which the specific envelope elements proposed by the industrial partners are integrated into.

The Task is performed in two parallel and interacting activities:

1. Solutions that are technically and economically meaningful will be identified by means of building and HVAC simulations. A decision support instrument (pre-design tool) will be developed as part of this activity, allowing simplified calculations to be performed.
2. Existing systems will be evaluated by monitoring demonstration systems installed.

The solutions will be evaluated based on reference conditions assessed in Subtask A, and sub-systems and KPIs defined in Subtask B.

Activities description:

Activity C.1 – Building models elaboration and systems definition

Activity C.2 – System simulations

Activity C.3 – Technical, environmental and economic analysis of the simulation results

Activity C.4 – Analysis of monitoring results

Activity C.5 – Predesign tool development

4. Expected Results/Deliverables

The deliverables, allocated to the three Subtasks, will be:

A.1 State-of-the-art on existing solar envelope systems

A.2 SWOT analysis based on the state-of-the-art information available

A.3.1 Updated Task website (on-going)

A.3.2 Two annual newsletters for the dissemination of on-going activities

A.3.3 Annual workshops with targeted stakeholders

A.3.4 Online glossary of Task vocabulary and definitions

A.3.5 Database of contacts for dissemination activities

A.3.6 Coordination and dissemination of final deliverable (printed handbook or free online publication)

B.1 Report on workshops for the identification of barriers for new solar envelope systems

- B.2 Report on the development of strategies for market penetration
- B.3 Report on confidential feedback workshop on current developments
- B.4 Report on simulation models of solar envelope components
- B.5 Report on test methods and recommendations

- C.1 System Simulation Models
- C.2 System Simulation Results
- C.3 Design Guidelines
- C.4 Monitoring Results
- C.5 Decision/(pre-)design Tool

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 participate in the editing and reviewing of draft reports of the Task and Subtasks
- (c) Each country will bear the costs of its own participation in the Task, including necessary travel costs.
- (d) The Participants agree on the following funding commitment:
 - 1) Each Participant (country) will contribute to this Task a minimum of **3-person months per year** of the Task, i.e. a total minimum of **1 person years**.
 - 2) Participation in the Task requires participation in at least one of the Subtasks.
 - 3) The Operating Agent will contribute with a minimum of **2-person months per year** to the Task.
 - 4) The Subtask leader shall commit a minimum of **2-person months per year** to the Task.
 - 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) The level of effort to be contributed by each country will be specified in a "Letter of National Participation" which is signed by the Operating Agent and the Executive Committee representative within 3 months from the start date of the Task."

6. Management

6.1 Operating Agent

Italy, acting through Roberto Fedrizzi (EURAC - European Academy of Bolzano), is designated as Operating Agent.

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 Articles 5 of this Agreement, the Operating Agent shall:

- 1) Prepare and distribute the results mentioned in Article 4;
- 2) 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;
- 3) Provide reports semi-annually to the Executive Committees on the progress and the results of the work performed under the Programme of Work;
- 4) 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;
- 5) 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;
- 6) Provide the Participants with the necessary guidelines for the work they carry out with minimum duplication;
- 7) Gather documents from Subtask Leaders, edit and distribute the output of the Task either as a printed handbook, electronically or on a website.

6.2 Subtask Leaders

A Subtask Leader for each of the foregoing Subtasks shall:

- 1) Co-ordinate the work performed under that Subtask;
- 2) Assist the Operating Agent in preparing the detailed Programme of Work;
- 3) Direct technical workshops and provide the Operating Agent with written summaries of workshops results and
- 4) Edit technical reports resulting from the Subtask and organise their publication.

- 5) Subtask leaders may arrange meetings in between or in association with Experts meetings of the Task.

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.

6.3 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. It is intended to organize expert / industry workshops every year, directly linked to Task meetings.

6.4 Dissemination

The overall scope and objectives of the Task and the different Subtasks will be described on a public website, possibly the IEA-Task website. The server should be able to process an automatically distributed electronic newsletters.

7. Admission, Participation and Withdrawal of Participants

Admission, Participation and Withdrawal of Participants is subject to the rules of the Implementing Agreement. Share of results produced will be subject to the active contribution of each Participant to the above mentioned activities.

8. Information and Intellectual Property

For purposes of this Annex, in case of conflict with the provisions of the 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:
 - i. On the most favourable terms and conditions for use by the participants in their own country; and
 - ii. 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 Extensions

This Annex shall enter into force on February 1st 2016 and shall remain in force for a period of 4 years until 31st January 2020. 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.