



**Project no. SES6-CT-2003-503777**

**BIPV-CIS**

**Improved Building Integration of PV by using Thin Film  
Modules in CIS Technology**

Specific Targeted Research or Innovation Project

6.1 Sustainable Energy Systems

**Publishable final activity report**

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## **1 Project execution**

### **1.1 Motivation**

Building integration of PV systems leads in most cases to a “high tech” and “modern” appearance of the building, caused by the typical window-like surface of most conventional PV modules. Considering however that 90% of the building stock consists of already existing and “old fashioned” buildings, it is evident that an aesthetically satisfying building integration of PV needs a lot of good will from planners and creativity from architects. In many existing building-integrated PV systems the modules do not harmonise with the building and its surroundings. Based on experiences like this, conflicts with urban planners are not unlikely.

Therefore special attention had to be paid to architectural and aesthetic questions.

Furthermore the market for refurbishing and modernisation of old buildings is much larger than the market for new buildings. Therefore it is not only an aesthetical but also an important economic issue to open up this market.

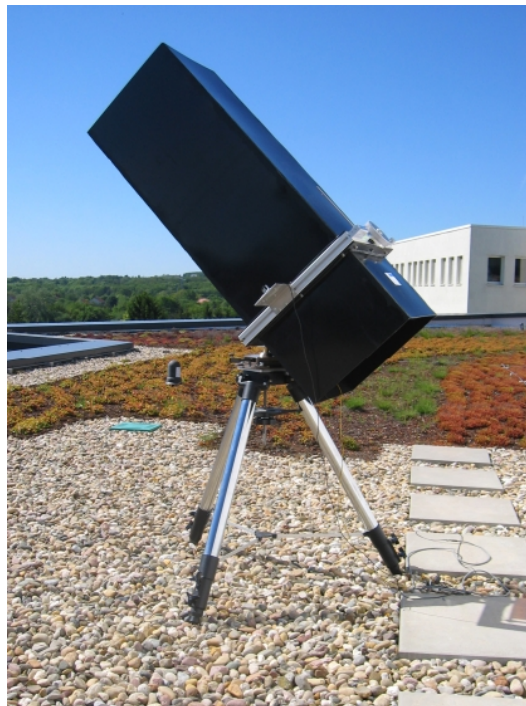
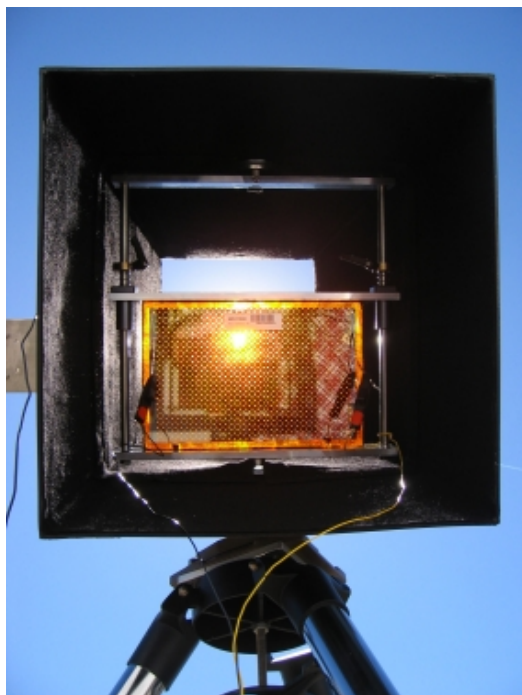
### **1.2 Project Structure**

There was a very broad approach to building integration of CIS modules as two proposals were merged by the European Commission. The project consortium consisted of seven industrial partners, two research institutes and three universities. The project was co-ordinated by the Zentrum für Sonnenenergie- und Wasserstoff-Forschung, Germany. The partners are Würth Solar GmbH & Co.KG (D), Avancis GmbH & Co.KG (D), Ove Arup & Partners (GB), Scheldebouw (Permasteelisa Group) (NL), Saint Gobain Recherche (F), Swiss Solar Systems AG (CH), Tyco Electronics AMP (D), European Joint Research Centre in Ispra (I), Technische Universität Dresden (D), Warsaw University of Technology (P) and Wroclaw University of Technology (P).

### **1.3 Project Work**

Integration of PV into the ventilated building skin as well as into the insulated building skin, a CIS roof tile for roof integration at reasonable cost, a junction box and electrical connectors were developed within the project. Beneath these technological issues aesthetical and legal aspects were investigated.

A technical screening of patterned, matt-finished and coloured cover architectural glasses regarding aesthetical aspects and their usability in modified CIS thin film modules was carried out. 35 glasses were measured in detail. The angle dependant behaviour of patterned glasses was examined for both laminated and non-laminated decoupled modules using opaque and semitransparent CIS substrates.



Apparatus for the measurement of angle-of-incidence dependence of CIS PV modules with modified appearance. Photo: ZSW

Enquiries on cover glass prices and delivery conditions for patterned, delustrated and coloured cover glass were carried out. Furthermore the module verso appearance of CIS modules was examined.

Legal and administrative aspects were taken into consideration in studies elaborated concerning European building regulations which strongly influence the construction and dimensioning of the modules and often forbid the use of what is known as standard PV modules in building integration. Further, European surveys on roofing elements and on mullion transom construction were elaborated.

A market study was carried out in the frame of four seminars that were held at Newcastle (UK), Madrid (E), Milano (I) and Amsterdam (NL). With discussions and feedback from the market study seminars concerning visual appearance, performance, cost, general BIPV issues and questionnaires from all delegates a detailed overview on market need was elaborated.

The above mentioned work lead to the realization of two small generators of approximately one kW and a mock-up. One transom mullion façade and one structural sealant façade with prefabricated elements containing CIS modules in double glazing units and a demonstrator of a façade element with more than 2 m<sup>2</sup>.



CIS modules, partially coloured, in double glazing units in the transom mullion façade at the ZSW test site Widderstall, Germany. Photo: ZSW

The second system is mountable from outside on a structural silicone application. There is no visible external frame between the individual elements and no shading which advantageous for the PV modules. The complete façade is mounted with the pre-assembled PV-Modules and also replacement can be done from outside.



General view of the tested CIS modules modules in double glazing units on a structural silicone frame. Photo: Scheldebouw

A cost optimised junction box especially suited for thin film modules was developed in the project. The limitation to only one bypass diode per box allows a reduction in both size and cost. It is also possible to use the box for parallel interconnection of the modules. In the meantime it is available as an industrial product. A solution for the invisible connection for modules integrated in the insulated building skin has been developed as a prototype. The realised prototype fulfils the latest updates of the relevant standards.



Small junction box for thin film PV modules. Photo TYCO

A PV tile for roof integration based on a frame which is realized by injection moulding around a CIS module was developed as well. A European market survey on roof tiles and solar roof tiles was carried out. Material compatibility tests were done. It was found, however, that the economic advantages of thin film technology concerning small sizes were lower than the industry partner had expected. Therefore this part of the project was finalized at the planning and testing level.

An important part of the project was the qualification and performance of the CIS modules. Therefore CIS modules were installed outdoors at Widderstall (Germany), Ispra (Italy), Warsaw and Wroclaw (both Poland) for a detailed electrical monitoring. One PV façade was successfully tested according to the relevant façade standards on water and air tightness.

Considerable activities on the dissemination of project work lead to 48 presentations, publications, exhibitions or workshops.



## 2 Dissemination and use

result description	<b>small junction box for thin film modules</b>	<b>PV modules with optically delustered coloured front glass</b>	<b>Structural sealant façade with thin film PV modules</b>
features	<p>small, compact housing</p> <p>optional integrated bypass diode</p> <p>automated manufacturing</p> <p>easy handling in case of hand production</p> <p>according to the PV-standards of TUV and UL</p> <p>attractive market price</p>	<p>lamination-free module construction</p>	<p>no visible frame between the individual elements</p> <p>no shading for the PV modules</p> <p>complete repair and replacement of PV-elements from outside</p>
market application	the whole PV thin film market	BIPV applications	advanced BIPV applications
stage of development	industrial product	demonstrator realized	mock-up realized, industrial product
collaboration	none	manufacturing agreement, licensing	manufacturing agreement, licensing
collaborator details	none	PV industry or glass machinery supplier	PV industry or glass machinery supplier
IPR	know-how of the company	applied for patent	know-how of the company
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