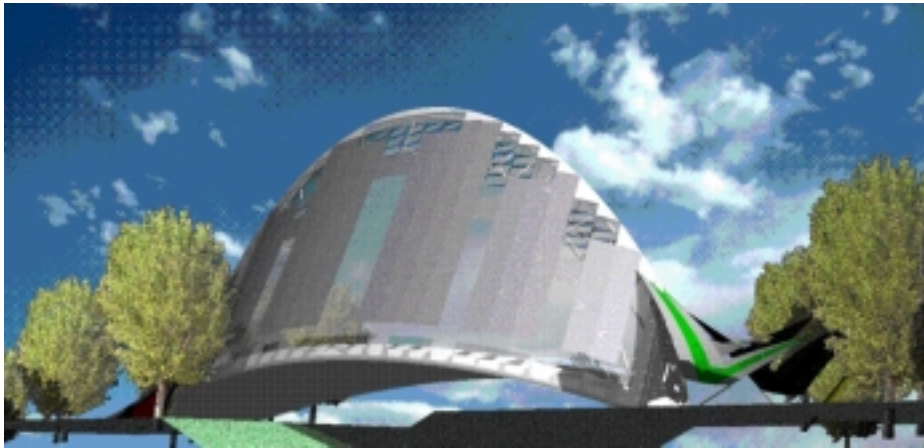


# Solar Power Envelope

JOR3 CT97-01891

JOULE III



## Objective

The main objectives of the project were:

- develop and test a transparent, high performance energy producing building system
- evaluate energy performance and user acceptability of this glazed zero energy building
- develop and build a zero emission daylight office building

## Starting point – the vision

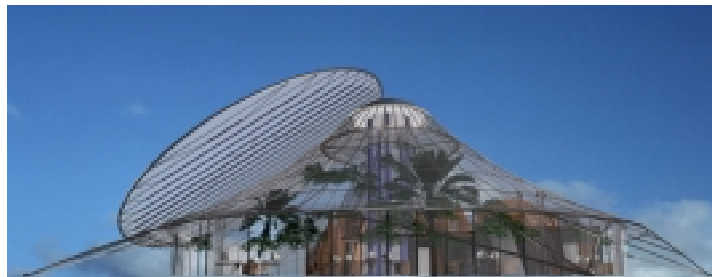
Move the office to Bounty land:

Create a more healthy office building with an improved indoor visual climate – an office building that further provides more energy than it consumes

## Focus of the project

The project was focused on the below areas:

- development of a high performing building envelop with electricity production, low U-value and fluttering system for the sunlight
- industrialised mounting system
- build a full-scale pilot building
- test the performance of the building in an occupied environment



# Solar Power Envelope

The high performing building envelope is based on the vacuum glazing technology as shown in figure 1. The aim of the project was to obtain an U-value of 0.5 W/m<sup>2</sup>K. On the outer surface of the vacuum glazing strips of PV cells are situated with a lens system on top. The aim of the lens system is to focus the direct solar radiation on the PV strips while letting the diffuse radiation through the glazing system. The system thus reduces the traditional drawbacks of highly glazed buildings: large heat losses during periods with low or now solar radiation and overheating during period with direct solar radiation. Figure 2 shows the intended performance of the lens system, while figure 3 shows a real glazing system.

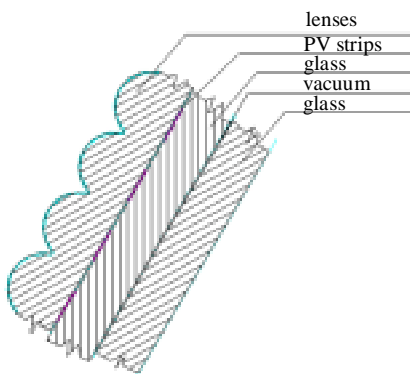


Figure 1 The PV glazing system of the Solar Power Envelope

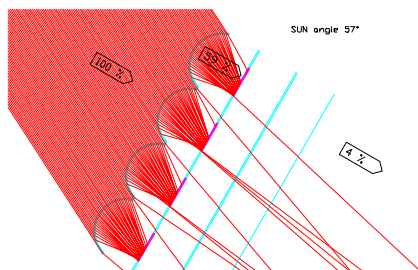


Figure 2 Example of the filtering of the solar radiation due to the lenses

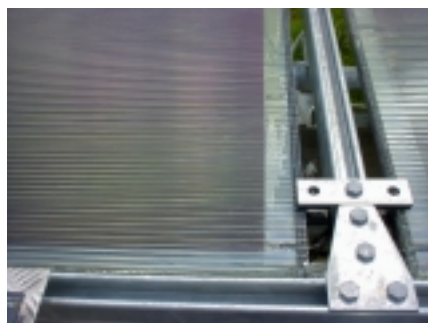


Figure 3 Real PV glazing system

## Mounting

The purpose of the mounting system is to eliminate the cool bridges at the joints of the PV glazing panes and to allow for an industrialised mounting technique. Several different methods were investigated – figure 4 shows one example.

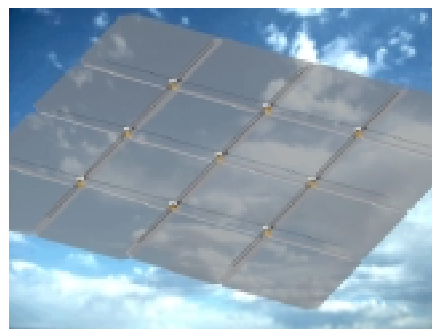
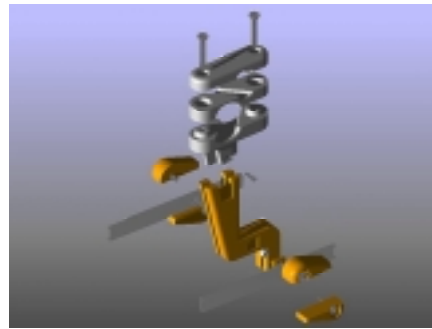


Figure 4 Example of one of the mounting systems for the PV glazing panes

## Pilot building

Several designs of an office building with the Solar Power Envelope were developed as seen in the following pictures. The aim of the investigation was to develop a cheap and easy erectable building concept.

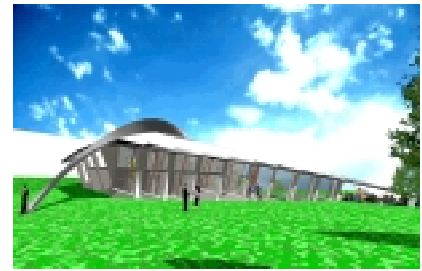


Figure 5 Examples of investigated designs

## Comfort and energy flows

Comfort conditions and energy flows have for all the designs of the office building been evaluated using EU reference simulation program for determination of the thermal performance of buildings: ESP-r and CFD codes.

The main conclusions from the investigations were:

- Increased glass area should neither change the average U-value, nor the maximum solar gains to the building
- The cost of the extra outer envelope should be less expensive than what is saved on the insulation and weather proofing of the covered building with the same overall energy performance
- In a fully glazed building effective U-values should be based on diffuse light only and true U-values including losses along the edges of the glass panes as well as losses through the framing profiles

## Conclusions

The Solar Power Envelope (SPE) was a very ambitious project with a lot of risk multiplied with each other. Furthermore success was dependent of R&D outside the budget and control of SPE. The delay in research outside SPE in PV and industrialisation of evacuated glazing proved to be fatal to the project. Without the high performance PV and large evacuated glass panes the criteria in the contract with EU could not be met within the midterm deadline. The project was, therefore, stopped for the time being.

Most other technical and design problems were, however, solved:

- Design of the building
- Focusing lenses for PV
- Lamination of evacuated glazing
- Fittings
- Reduction in thermal bridges

A lot of scientific knowledge was accumulated.

In a few years high performance PV strips and industrialised evacuated glazing might indeed be available. The idea of the Solar Power Envelope may then be taken up again.