ENERGYbase office

Introduction

In the early 2000 years an urban development competition was started for the area of today's AIT-location 'Giefinggasse'. After that design processes started. The AIT Austrian Institute of Technology was not only involved as user, but had the chance to do detailed simulations and to consult the building design (2004). They carried out several simulations (i.e. thermal system, air flows, energy & user comfort, design of living lab PV-installation with inverter test facility) and were involved together with other researchers and the architects. Tim Selke (AIT) was working as scientific planning supporter on the project design. Ursula Schneider (POS architects) was responsible for the architectural design. The installation was funded by the 'Ökostromfonds Wien' of the City of Vienna. The overall construction was funded by the European Union and the Ministry for Technology ('bmvit'). The research studies to enable the general concept generation and the scientific simulations of the energy system were funded in the frame of the 'Haus der Zukunft' (Building of the future) program.

Source: Successful Building Integration of Photovoltaics – A Collection of International Projects

Aesthetic integration

"Architectural, design and functional integration including solar power generation optimization was more important than to substitute building materials" (Ursula Schneider, POS architects). The PV modules are integrated in a way that they do not form the 'façade cladding' of the building. When they would be taken away, nothing would need to substitute them, as the façade would be rainproof, atmospheric shielded and the opaque elements would provide the shading just as today. The PV system was deeply integrated in the building's appearance, design, geometry and functionality.

Energy integration

The only 'external' energy-supply used and consumed in the building is electricity. The monitoring from 2009 till 2015 reviled that the BIPV system provides from 23% up to 34% of the annual amount of electricity needed for the building operation, with a specific yield up to 983 kWh/kWp (i.e. about as much as a roof top system would produce). Furthermore, from 69% up to 77% of the annual PV electricity production resulted to be self-consumed by the building operation. With an optimal orientation and maximum irradiation, the modules are part of an 'energy design' façade, which is able to produce energy, shade the interior rooms (i.e. less electricity and thermal energy needed for cooling), optimize the daylighting and reflect light towards the PV modules. The modules indeed are installed on opaque shading elements. These elements guarantee the internal thermal and visual comfort, helped by sun-blinds, that were introduced against glare in winter time or during morning and evening hours, when the sun comes from a tilted angle. (Tim Selke, AIT)

Technology integration

364 glass-glass PV modules are integrated as ventilated façade elements in six long stripes. They are installed on top of a sheet metal layer with horizontal aluminum profiles on which they are hold with glass fasteners. The free ventilation is allowed behind the PV modules to achieve the maximum energy performance. Besides electricity generation, the BIPV system serves as a 'living lab' regarding two aspects: test of different solar cell types (i.e. monocrystalline, polycrystalline, polycrystalline with back contact), and test set for inverters (different string length with 2, 4, 6, 8 and 10 modules in series, with

the option to combine the PV-modules and the strings in numerous variations in series or parallel) (Tim Selke, AIT).

Decision making

To host the newly combined AIT institute, the Vienna Business Agency was enthusiastic to realize an energy lighthouse project, developing the place as a technology location. A study called ‘sunny building’ showed the feasibility to realize an outstanding solar design with highest energy efficiency and user comfort standards (Tim Selke, AIT). The idea of a folded façade came up, trying to find something suitable for an office building and not architecturally boring and from a low quality for the architect. Opaque PV-elements would shade passively while the tilted glass would deliver daylight without too much heat inlet. From a high importance was, that on the one hand the view to the outside would be good and undisturbed by the opaque PV-elements and on the other hand the shading and daylighting of the interior should be optimal. The façade was therefore designed in a manner, that the lower row of windows would allow optimal views outside and that the upper row of windows would guarantee deep daylight rays into the office space. (Ursula Schneider, POS architects) Many simulations of variants were carried out to find the optimal thermal and visual comfort and shading/daylighting solution as realized with the folded PV-façade (Tim Selke, AIT).

Lessons learnt

ECONOMIC VIEW OF THE PROJECT

Building integrated Photovoltaic systems should not only be valued regarding their investment costs. The low operating costs of highly energy efficient buildings with a significant share of electricity produced by Photovoltaics have a long term value. In the ENERGYbase office, the occupants can enjoy very low operating costs. The specific electricity consumption per square meter useful floor area from the grid is only 14.4 - 18.1 kWhel. This means the specific energy costs for the building operation including ventilation, pumps, heating and cooling are only 2.88 – 3.62 € per useful area and year. This is extremely low.

INTEGRATION OF PHOTOVOLTAICS INTO THE DESIGN

The integration of solar and other renewable energy production and energy conscious design go hand in hand. In this process integration of PV in the building design and structure must not only mean lowering the efficiency of PV due to ‘design concessions’ such as color printing or other colors minimizing the efficiency. The structural integration into the design plays a significant role as well as does the functional integration.

CONTROLLING THE DETAIL IN PV-FACADES

The detailing plays a significant role in the performance of photovoltaic façades. While the free ventilation and the reflections of the glazing play a very positive role the effect of small projecting parts causing shade can’t be overestimated. Just minimal overlaps can cause long shades in the vertical as to be seen with the solar module overhang in this project. The geometry must be ambitiously controlled in every detail in PV-façades to avoid any shading.

COMMMUNICATIONS AND SOLAR ARCHITECTURE COMMITMENT

The ‘Future Base’, built ca. 10 years later by the same owner and the same occupant was built as a highly efficient building. But no special solar design was applied, only a minimum of roof top PV. However the general energy standard and the main components of the energy system were copied from the ENERGYbase to this building as well as to another building in Aspern. Obviously the engagement of a ‘solar architect’ is still a must have for an advanced ‘solar design’.

PUBLIC FOUNDING FOR EXTENDED BUILDING DESIGN RESEARCH VERY VALUABLE

To be able to do such extensive simulations and differentiated planning process as well today a public research funding will be necessary. More research programs as such should be carried out.

OPEN SPACES ARE OPTIMAL FOR COMMUNICATION ZONES AND COMMON USAGES, BUT NOT FOR INDIVIDUAL WORK PLACES

The open space looks great and is very functional as a community area, but proofed not very favorable in terms of individual work places. While the option for a spatial division into single rooms would have been easy to be planned it was not done. As the ventilation concept is laid out for cross ventilation from south to north it is not easy enough to change this spatial arrangement. However with user’s needs known as today the façade concept could have been easily adapted to the wish for privacy and a silent working environment. Furthermore each user should have access to individually openable windows. So flexibility in use should include the option of individualization regarding office work spaces. This needs to be reflected in HVAC-concepts as well.

TODAY WE COULD REALIZE IT "PLUS ENERGY"

At the time being it was not possible to directly sell the solar electricity from the building and PV-owner to the occupants. Today there are other options recently opened in Austria for ‘community PV-plants’. This means today much more PV could be installed on the building to make it ‘plus energy’ or to supply as well the user’s electricity needs with solar power generated by the owner.

PROJECT DATA

Project type	New construction
Building use	Office
Building address	Giefinggasse 2, Vienna, Austria

BIPV systems

BIPV SYSTEM DATA

Architectural system	dispositivo ombreggiante
Integration year	2008
Active material	silicio policristallino e monocristallino
Module transparency	Opaque
Module technology	Glass-backsheet, recognizable PV, customized modules
System power [kWp]	48,2
System area [m²]	400
Module dimensions [mm]	1520 x 710
Modules orientation	sud
Modules tilt [°]	31,5

BIPV SYSTEM COSTS

Stakeholders

Main building designer

Ursula Schneider (POS architects)

BIPV components producer

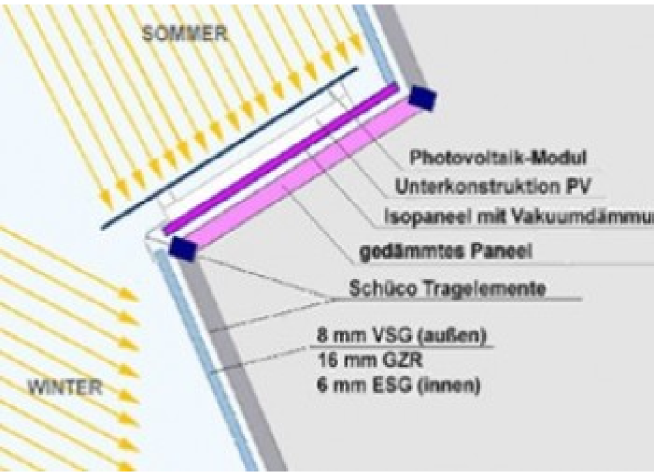
SOLARWATT GmbH
Maria-Reiche-Straße 2a, Dresden, Germany
info@solarwatt.com +49-351-8895-0
https://www.solarwatt.com/

Consultants

Tim Selke (AIT Austrian Institute of Technology)

Open plan office © AIT

Folded BIPV façade © AIT-POS Architecten



Façade section © AIT-POS Architecten

Detail of the fixation © BEAR-iD

Zig-zag-BIPV façade with six stripes of PV and solar thermal collectors on the top © AIT-Johannes Zinner

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