



## Solar Silo



Operazione co-finanziata dall'Unione Europea, Fondo Europeo di Sviluppo Regionale, dallo Stato Italiano, dalla Confederazione elvetica e dai Cantoni nell'ambito del Programma di Cooperazione Interreg V-A Italia-Svizzera. (Codice progetto 603882)

## Introduzione

The Solar Silo building is part of the former industrial site "Gundeldinger Feld" in Basel that represents a sensitive area of about 12,700 m<sup>2</sup>. The discussed industrial area was bought by Gundeldinger Immobilien AG, then, in 2000, the responsibility for the redevelopment of the site was handed over to Kantensprung AG. For the redevelopment of this area architects and project developers were required to be capable of embracing a social vision to shape the interactions of work, culture and leisure in a densely populated area. Moreover, from the beginning, Gundeldinger Feld was recognised as a pilot project of the 2000 Watts Society ([www.2000-watt.bs.ch](http://www.2000-watt.bs.ch)) and the renovation of the district was pursued in accordance with sustainable neighbourhood development. On the Solar Silo building, good practices were investigated for integrating BIPV modules as innovative cladding materials and new energy storage strategies. It is an old coal depot with a thermal power plant for the industrial area that has been converted into a multifunctional building.

Sources: [Polo López C.S.](#), [Baubüro in situ ag](#), [Swissinso](#), [SUPSI/ISAAC](#)

## Approccio progettuale

The almost 20-metre high coal silo located in the heart of the old industrial area was the only building that had not yet been put to other uses due to the inconvenient surface-to-volume ratio. The industrial coal silo was modernised and transformed into a highly energy-efficient multipurpose building through a restoration process. The outside of the building was plastered and thermally insulated, and coloured photovoltaic modules were installed. New openings were made in the façades, and the windows were replaced. The bearing structure of the old building remained intact. By adding three cement floors in the silo rooms, 200 m<sup>2</sup> of office space was created.

## Integrazione estetica

Since the area affected by the transformation process is under protection by the Swiss heritage offices, the renovated building, although not protected, must not betray the style and colour scheme of the old industrial area converted into a new energy district model. The original structure of the old coal silo is still recognisable after the operation. The photovoltaic modules in four different colours – gold, grey, green, and blue – create a unique chromatic effect, but the configuration of the original building remains intact.

## Integrazione energetica

The BIPV modules have been installed to produce electricity to be used directly for reducing the electricity demand from the grid. In fact, the BIPV system is able to cover about 37% of the total energy demand of the building estimated as 44,400 kWh/year. Moreover, as an R&D project, each module of the roof is monitored and the whole PV system is combined with a second-life battery energy storage system for studying how to better optimise self-consumption of electricity in the area.

## Integrazione tecnologica

The BIPV modules (Kromatix®) have been used as building materials for both the building's façades and

the roof. Indeed, they represent the cladding elements of the ventilated façades that have been constructed to improve the thermal energy behaviour of the existing envelope that was made of concrete. The façade modules have been mounted by means of metal mounting backrails and fixed by small clamps on the long edges of the modules. Similarly to the façades, the roof's modules are used as large slates creating a water-bearing layer of the ventilated roof that has been created with a wooden substructure on the thermal insulation layer. In both cases, the air cavities behind the BIPV modules represent an advantage for the thermal-hygrometric behaviour of the envelope and for the energy performances of the modules. The modules, with standard dimensions on the roof and few customised sizes on the façade, are characterised by a coloured coating on the inner surface of the outer glass that slightly decreases the system efficiency.

## Processo decisionale

Every year, Kantensprung AG invests more than 200,000 CHF in energy economy measures to renovate buildings gradually. Within the process of redevelopment of the former industrial site "Gundeldinger Feld", the BIPV technology was integrated into the envelope of the Solar Silo both to provide a visible sign of the shift from fossil fuels to renewable energy and to pursue the objectives of the 2000 Watts Society thanks to renewable energy production.

## Lessons learnt

The original purpose of a silo was to stock coal needed for heating the entire area. Therefore, the building became a symbol for the transition from fossil fuels to renewables for the whole area, thanks to BIPV that can be seen by visitors to the site. In the past, architects had to convince people to choose BIPV, but today this is changing. Some good examples of integrated BIPV in façades are needed to create a picture of the possibilities in people's heads. In this building, the glass of the coloured BIPV modules was designed not to reflect solar light so that there would be no glare effects. The design team received positive feedback regarding the aesthetics of the building and the modules. Some people wondered what kind of material were used on the façades, they don't recognise it as PV! (Arch. Kerstin Müller, Baubüro in situ AG)

Solar Silo has a long history, related to Gundeldinger Feld. Indeed, the whole area has been renovated and transformed into a multipurpose district adopting the sustainability concept in a wide and holistic perspective, ranging from energy to cultural aspects. It is worth considering that re-building the whole area would have meant a lot of embodied energy, so they tried to find a balance, including economically, for the entire area. Therefore, step by step, the entire site has been renovated, using thermal insulation, good energy-performance glazing, while also considering water recycling. (Mr Thierry Bosshart, iRIX Software Engineering AG) For instance, it was decided to reuse some existing materials (e.g., cladding for the external elevator and the kitchen) and to integrate solar energy sources into the existing building envelope (Arch. Kerstin Müller, Baubüro in situ AG).

As an R&D project, this pilot BIPV building is offering the opportunity to continuously learn from the interplay of electricity production, consumption and storage. The installation of BIPV modules on the Solar Silo, indeed, has been equipped with many sensors, aimed at evaluating the real power output of each single module. This is allowing to record the performances of the differently coloured modules over time and compare their real electrical behaviour with the declared values.

For this R&D project there was not a predefined business case. Instead, all implemented renovation

measures have been adopted step by step, considering also the economic aspect of sustainability. For instance, existing building materials have been reused to reduce both investment costs and environmental impact. This building project is promoted as a pilot project by the Office of Environment and Energy of the Canton of Basel City and the Federal Office for Energy and, specifically, the former supported this pilot project with a funding for coloured BIPV modules. This project was awarded with the Swiss Solar Prize 2015 in the "Renovation" category.

The collaboration with the building conservation department was significant considering the complexity in integrating the new BIPV elements in the specific context.

The transformation process in the area led to the creation of cultural, social, and commercial flows that positively impacted the neighbourhood.

## DATI EDIFICIO

<b>Tipologia progetto</b>	Riqualificazione
<b>Destinazione d'uso</b>	Uffici
<b>Tecnica di costruzione edificio</b>	Movimento moderno
<b>Indirizzo edificio</b>	Dornacherstrasse 192, Basel, Switzerland

## Sistemi BIPV

### DATI SISTEMA BIPV

<b>Sistema architettonico</b>	Opaque roof, rainscreen
<b>Anno integrazione BIPV</b>	2015
<b>Active material</b>	Monocrystalline silicon
<b>Trasparenza modulo</b>	Opaco
<b>Tecnologia modulo</b>	Strati di vetro, FV non riconoscibile, modulo customizzato
<b>Potenza sistema [kWp]</b>	24
<b>Area sistema [m<sup>2</sup>]</b>	159
<b>Dimensioni modulo [mm]</b>	Several
<b>Orientamento moduli</b>	South (roof, façade), North (façade)
<b>Inclinazione moduli [°]</b>	11 (roof), 90 (façade)
<b>Produzione FV annuale [kWh]</b>	16428

### COSTI SISTEMA BIPV

<b>Costo totale [€]</b>	103800
<b>€/m<sup>2</sup></b>	653
<b>€/kWp</b>	4325

## Stakeholders

### Progettista principale

baubüro in situ AG

### Progettista sistema BIPV

AGROLA AG (Solvatec)

### Installatore sistema BIPV

AGROLA AG (Solvatec)  
Bordeaux-Strasse 5, Basel, Switzerland  
solar@agrola.ch 058 433 73 73  
<https://www.agrola.ch/>

### Produttore componenti BIPV

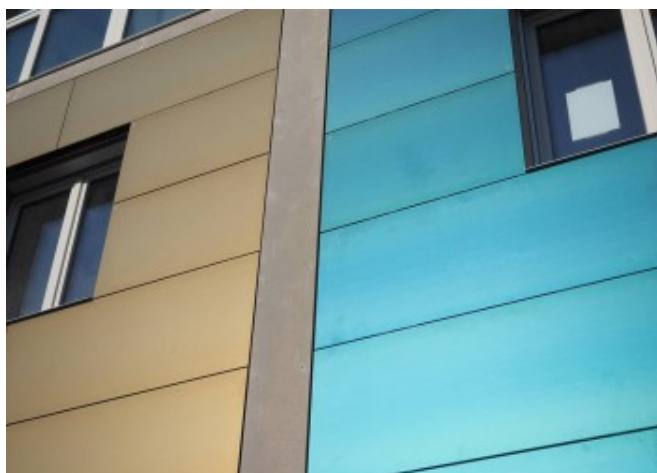
Emirates Insolaire L.L.C  
Dubai Investment Park 1, Dubai, United Arab Emirates  
info@emirates-insolaire.com 04-8122726  
<http://emirates-insolaire.com/>



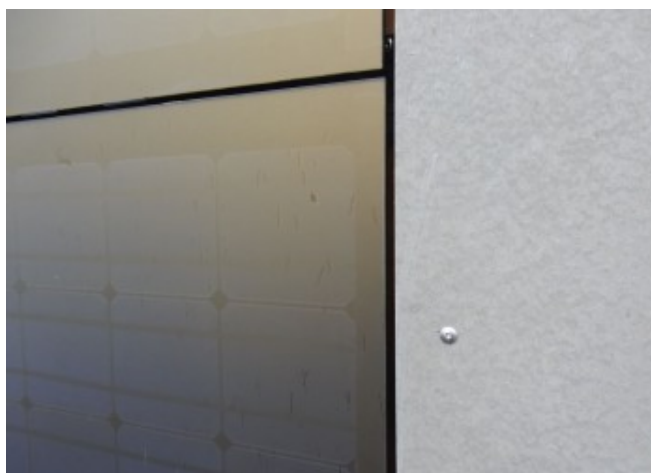
Historical picture of the Gundeldinger Field © Baubüro in situ AG



Detail of blue BIPV modules © Martin Zeller



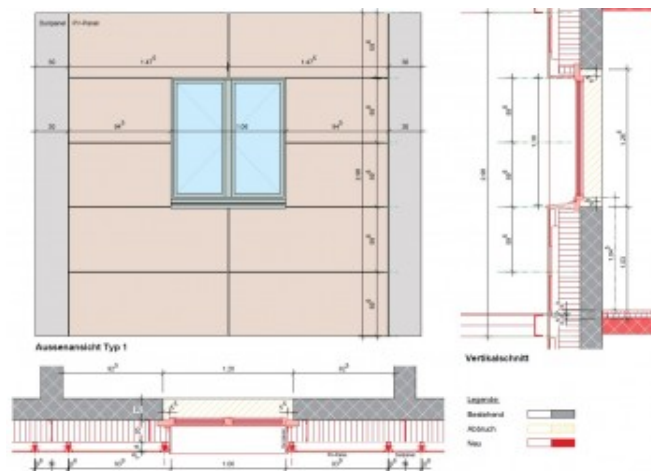
Different colours of BIPV façade © Martin Zeller



Detail of gold BIPV modules © Baubüro in situ AG



Mounting of the BIPV façade © Baubüro in situ AG



Technical drawings of the BIPV façade © Baubüro in situ AG

Autore caso studio:

SUPSI, Eurac Research