CIEMAT office building

Aesthetic integration

The BIPV system is integrated into the ventilated façade of the three-story building. The building is located at the Ciudad Universitaria Campus in Madrid, and it is visible from the access road and the main avenue. The PV modules are combined with the polymer concrete panels used on the façades, achieving a good integration from an aesthetic point of view thanks to the similarity of colors and shapes. However, the integration has not sought to conceal the photovoltaic modules; rather it has been considered that making them visible has a positive effect and provides a modern, exemplary image. (Arch. Juan Carlos Gutiérrez - Architecture & Project Unit of Ciemat)

Energy integration

The rated energy of the BIPV system is 20 MWh/year. The PV modules are distributed over the south, east and west facades, to achieve a flatter generation curve throughout the day, contributing to feed the building's baseline load along the year. All the energy generated is instantaneously self-consumed in the building, which means a self-consumption index of 100 %.

Technology integration

The BIPV system is made of large standard high efficiency PV modules, made of glass/EVA/PV cells/EVA/white PVF. The PV modules (SunPower E18-305W and E20-327W) form part of two photovoltaic installations: one of 27.2 kWp connected to the building's local electric power grid, and another stand-alone of 4.8 kWp. They occupy a total surface area of about 172.9 m^2, replacing conventional construction elements on the upper areas of the east, south and west façades. They are back ventilated (not tight air chamber of about 100 mm). The east façade PV system is divided into three sub-systems to reduce losses due to partial shading caused by nearby trees. The PV modules are fixed to a galvanized steel support structure, in parallel to that of the rest of the façade.

The PV system was provided with the "zero injection" device that prevents PV energy from being dispatched to the electric power grid outside the building, in compliance with the Spanish legislation at the time of the renovation. The device monitors the electrical network and photovoltaic inverters at all times to modulate photovoltaic production in relation to electrical consumption in order not to send energy to the grid. (Javier Pérez, PV installer)

Decision making

The decision of integrating PV into the building façade was led by the architect of the center, Juan Carlos Gutiérrez, in charge of the rehabilitation project, and supported by the General Director of CIEMAT, the Director of the Renewable Energies Division and the Photovoltaic Unit. The building had to be retrofitted after the technical municipal inspection, and the ventilated façade for the outer envelope of the building appeared as the most suitable option. The retrofit building would become a showcase of the inside i+D activities and, at the same time, demonstrate one easy to reproduce BIPV solution.

The type of material for the ventilated façade was defined on the basis of the PV modules' characteristics, seeking a product that would allow for similar dimensions, such that someday, if necessary, the PV panels could be interchanged without detracting from the general appearance of the whole of the façade, and adapting the modulation and the general appearance to these elements such that the integration would be as effective as possible. (Arch. Juan Carlos Gutiérrez - Architecture & Project Unit of Ciemat)

Lesson learnt

There are no subsidies or economic incentives, but the installation saves energy consumption from the grid: it is a 100 % self-consumption case. The total cost of the installation, including maintenance and reposition of the PV inverters (once in 30 years), is 2.7 €/Wp. Discounting the cost saved in conventional façade, the net cost of the BIPV installation becomes 1.84 €/Wp.

This is an example of a non-expensive, easy- to-implement good architectural solution for building retrofit with standard PV modules integrated in a new ventilated façade. The effect of shadowing caused by the nearby trees may be significant, so if not possible to avoid, at least divide the system in different parts to reduce energy losses.

PROJECT DATA

Project type	Retrofit
Building function	Office
Integration system	Opaque cold façade
Location	Avda. Complutense 40, 28040 Madrid, Spain

BIPV SYSTEM DATA

Module type	Standard modules
Solar technology	Monocrystalline Silicum
Nominal power [kWp]	32
System size [m²]	172.9
Module size [mm]	1,046 x 1,559
Orientation	Easth, South, West
Tilt [°]	90

BIPV SYSTEM COSTS

Total cost [€]	76,000
€/m²	439.6
€/kWp	2,700

PRODUCER DATA

Producer	SunPower
Address	-

Contact	-
Web	-

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1. CIEMAT office renovation with BIPV cladding (© CIEMAT)
2. CIEMAT office with project team (© CIEMAT)
3. CIEMAT office with the access road (© CIEMAT)
4. Renovation work details. PV modules mounting (© CIEMAT)
5. Supporting structure and fixation details (© CIEMAT)
6. Renovation work finished (© CIEMAT)