Single-family house in Ulestraten

IEA PVPS

Introduction

A full roof BIPV solution was chosen to be integrated in the single-family house, a renovated detached dwelling in Ulestraten. On average the planning takes about four to five weeks after which the work on-site will be executed within four days.

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

Design approach

The process can be divided into some steps. First, the energy consumption and energy requirements for the next two years are determined and the condition of the building structure is examined. During the second step a suitable PV module based on energy requirements and roof surface is selected and a budget indication is prepared. The budget is discussed with the homeowner(s), the project is commissioned, the planning stage takes off. The work on-site then starts with removing the existing roof cover and installing the new BIPV roof.

Aesthetic integration

The BIPV system replaces the tiles on the south-eastern section of the pitched roof. On the opposite site of the pitched roof traditional tiles are installed. The BIPV roof has been engineered in such a way that it matches the thickness of the cross-section of the roof section covered with tiles.

Energy integration

The BIPV system is meant to help supplying the relatively high energy consumption of swimming pool heat pump and the electric car. It is expected to produce around 10,600 kWh/year.

Technology integration

92 standard thin-film CIGS modules (Solar Frontier) are installed on three roofs. The modules are mounted with aluminium frames designed and produced by BEAUsolar. Weather-tightness is ensured by three components. A water-tight, vapour permeable layer is installed on top of the existing roof deck. The mounting profile includes an integrated gutter system (second waterway). Finally, the solar modules with clamping profiles are primarily responsible for the weather-tightness of the dwelling. Taken together, the BIPV system encompasses a modular, flexible whole-roof system, completed by finishing and fitting pieces (plastisol typesetting). The modules are naturally ventilated due to the distance between the modules and the roof. The cavity space can be adjusted to ensure a neat connection with the adjacent roof surface.

Decision making

The private building-owner of this BIPV case project, a scientist and entrepreneur, wanted a sustainable investment and was already convinced by the application of PV. The investment was in particular motivated by the relatively high energy consumption due to the heat pump of the swimming pool and the electric car. At the same time, there was a need for roof renovation because the roof deck consisted of asbestos-containing sheets. (Mrs Caroline America, Mr Raoul Comuth, BEAUsolar).

Lessons learnt

Three scenarios in which potential clients could become interested in this solution are: building-owners who face an 'renovation anyway' of the roof, building owners who must create a new roof in the case of a newly constructed dwelling and building-owners who want to apply BIPV for aesthetic reasons in contrast to a traditional BAPV system. Typically potential customers are already acquainted with building integrated PV solutions. (Mr Raoul Comuth, BEAUsolar)

There are several arguments to invest in a whole-roof BIPV solution. First of all, investments in BIPV often links to sustainability and a green image because of the usage of solar energy. Timing of the decision to invest with 'renovation anyway' of the roof stimulates the application of BIPV. There is now no need to work on the roof twice with respect to installing PV and replacing the roof cover. Third, BIPV is more aesthetically appealing than BAPV. BEAUsolar offers an unique 'whole-roof' solution consisting of a completely plain roof surface. The solution is unique when it comes to the use of dummy modules in places where PV modules are not possible. The BIPV roof can be installed relatively quickly which also could be considered as an advantage. Finally, the PV system is financially competitive with a traditional roof and PV modules that are added to the roof structure (BAPV). (Mrs Caroline America, BEAUsolar)

The project was installed on time and within budget. The investment was 250 €/m2, which is comparable to other BIPV solutions. The expected payback time of the investment is about 7-9 years, whereas about five years applies for BAPV. There were no economic restrictions or any kind of subsidy involved regarding the BIPV in this particular project. Two additional economic incentives apply to this case but were not decisive in adopting the whole-roof BIPV. First, it has been calculated that energy costs will increase significantly in the coming years due to an increase in energy taxes. In addition to VAT, an energy tax and a Sustainable Energy Allowance must be paid over the costs for gas and / or electricity (the revenues from the Sustainable Energy Allowance are invested in energy efficiency by the Dutch government). Secondly, there is a net metering scheme that raises the value of excess electricity to the same level as self-consumption.

BIPV turns out to be competitive due to the combination of "renovation anyway" and installing BAPV. The BIPV needs to be offered at the right time, combining the demand for roof renovation and PV. One-stop-shop: having a single entity that is responsible for the design, engineering and installation of the BIPV is successful. The all-black, single-level design of the roof surface is preferred over BAPV. Despite a variety of possible obstructions in the roof surface (roof ducts, skylights, and dormer windows) the modular design offers flexibility to cover several roof typologies. The BIPV is installed within 4/5 days. The lead time of the project, design, engineering and construction can be limited to 6 weeks. To get the BIPV accepted and adopted in the market, it was learned that because of its innovative nature, potential clients need to be convinced of its maturity. First of all, detailed technological design specifications show that the BIPV is sufficiently designed and 'matured'. Next, showcases not only create awareness of BIPV but also help potential clients to understand how the BIPV appears. It is equally important to frame the BIPV in the correct way: 'integrated PV' versus 'aesthetic electricity generating roof covering producing energy'. In addition, it remains challenging to convince homeowners to adopt and install BIPV. There is a lack of clear understanding about cognitive decision-making processes of homeowners.

Installing BIPV initiated by a homeowner can have different motivations and financial schemes such as subsidies and energy-saving loans are not always decisive. Market consultation has been mentioned to increase the understanding of individually based decision-making and bias against BIPV.

PROJECT DATA

Project type	Renovation
Building use	Residential
Building address	Ulestraten, Netherlands

BIPV systems

BIPV SYSTEM DATA

Architectural system	opaque roof
Integration year	2016
Active material	CIGS thin-film
Module transparency	Opaque
Module technology	Glass-backsheet, hidden PV, standard modules
System power [kWp]	12
System area [m²]	90
Module dimensions [mm]	997 x 1,257
Modules orientation	South-East
Modules tilt [°]	30
Annual FV production [kWh]	10600

BIPV SYSTEM COSTS

Total cost [€]	22500
€/m²	250
€/kWp	1875

Stakeholders

Main building designer

BEAUsolar

BIPV components producer

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Design solution connection BIPV and dormer © J. van Oorschot

Design solution connection BIPV and eaves © Beausolar

Design solution connection BIPV and overhanging eaves © J. van Oorschot

Basic detail of the roof integration © J. van Oorschot

Street view showing the full roof BIPV © BEAUsolar

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