Copenhagen International School

IEA
PVPS

Aesthetic integration

The green, color changing façade is made by 6,000 m2 individually angled PV modules. The concept was to make the façade look like a fishtail and this was possible to achieve with a special nano-structure technique on the panels, where one color can appear in many different shades as the light changes through the day. In the Copenhagen International School BIPV is quite simply façade cladding. People should not perceive it as made of PV modules.

Energy integration

The school is built according to Energy Class 2020 (i.e. the total energy requirement for heating, ventilation, cooling, hot water and lighting per m2 of heated floor space does not exceed 25 kWh/m2 per year) in the Danish Building Regulations (BR) and so airtight, that cooling is necessary even in winter. The expected energy consumption for cooling is one of the main reasons for choosing PV, and the energy production from the BIPV is estimated to cover 50% of the total annual electricity consumption at the school.

Technology integration

The 12,000 photovoltaic modules are mounted on the walls with a mounting structure specially designed for the building. Each façade panel is made of a front panel (PV) and a cassette (aluminum) and the cassette gives the panel a slope of 4 degrees. As the modules are individually tilted in four different directions, and the building has 70 different façades, shadows on the BIPV façade through the day are inevitable. The effect of shadowing is minimized by the use of micro inverters who allow optimize energy yield for each 4 m2 BIPV façade. The micro inverters are placed under the ceiling plates just inside the building, to allow easy serviceability by the school´s technical staff and to minimize the operational cost in that way. All façades are covered with PV-modules as the intention is to achieve overall holistic impression. The PV-modules on the north façade are not connected and also functions as reserves in case a module fails electrically on one of the active façades. As the PV-modules are customized it makes replacement easy as the same size and colour is always available.

Decision making

From the beginning, the client (ECIS) included the idea of a BIPV façade into the building project. The goal was to be sustainable both economically, socially and in terms of energy consumption. BAPV on the roofs was never an option as they are used as playground.

Lesson learnt

It is important to keep BIPV in the discussion through the whole process as stakeholders can have bias against it. BIPV was about to disappear from the project a couple of times, but ECIS had an insisting vice chairman who kept BIPV in the discussion and at the same time was the driving person behind the design of the façade.

It has been challenging to develop and build a complex BIPV façade like this. The PV modules had to fit into the architectural module system and the shadowing effects minimized with micro-inverters. For the mounting it was complicated to move around with a lift to install 70 different façades with protrusions in all directions. It took a long time to build. Access to the façades with effective machines is a major factor for time needed for installation. The solar modules are customized, not standard. Together with the client we completed a large number of tests: climate chambers, wind tunnel, and structural strength of the mounting system and the electrical system with micro inverters. The PV plant worked for a short period, then it was stopped by the electricity grid utility for several months as the grid system was not prepared for input of electricity from large plants. Today, the plant is functioning again as planned. (Mr Peter Melchior Rødder)

The school established a property fund (ECIS) with the purpose of building a new school including the BIPV-system. ECIS was supported by five funds, of which one donated 27 million Euro to the construction of the school. The school is tenant at ECIS and must be run in the most economical way in the next many years. To achieve this is installed BIPV. The intention is to get the highest possible self-sufficiency in order to lower the operation costs as tenant.

PROJECT DATA

Project type	New construction
Building function	Public
Integration system	Opaque cold façade
Location	Levantkaj 4-14, Nordhavn, Denmark

BIPV SYSTEM DATA

Module type	Custom made modules
Solar technology	Monocrystalline silicon
Nominal power [kWp]	700
System size [m²]	6,000
Module size [mm]	700 x 720
Orientation	Several
Tilt [°]	86, 94

BIPV SYSTEM COSTS

Total cost [€]	-
€/m²	-
€/kWp	-

PRODUCER DATA

Producer	SolarLab
Address	Gunnar Clausens Vej 9, Viby, Denmark

Contact	info@solarlab.dk +45 6017 8031
Web	http://solarlab.dk/


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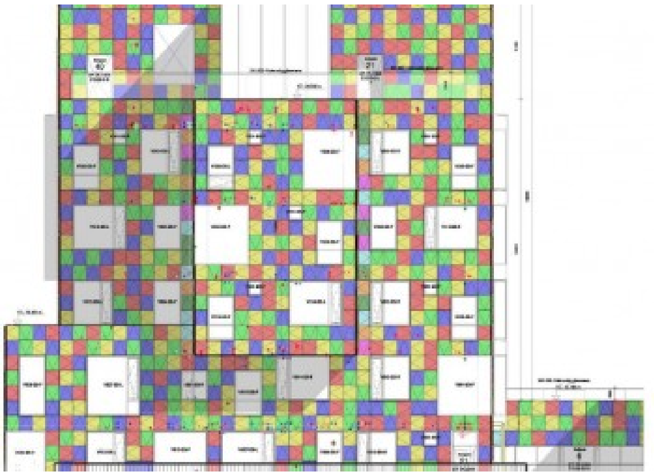
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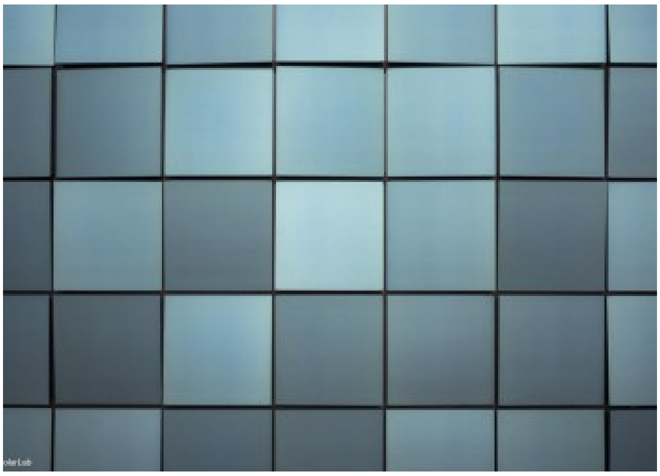
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1. BIPV north façade © C.F. Møller Architects / Adam Mørk
2. BIPV north façade © C.F. Møller Architects / Adam Mørk
3. Detail of BIPV façade © Karin Kappel
4. Drawing of how to place and angle the modules within the façade © C. F. Møller Architects
5. The façade system was tested in laboratories throughout Europe © Solarlab
6. Prototype of the façade with Kingspan elements, solar modules, mounting system with brackets and rails, silicon joints, was built for tests © Solarlab
7. Close-up of the façade: the colours are depending on the angle of the module © C.F. Møller Architects / Adam Mørk