Brynseng Primary School

IEA PVPS

Introduction

The school is a newbuild of around 11,600 m^2 net area and six floors, with a large multiuse sportshall at the upper level. It is designed for 840 pupils in year 1-7. The school is built on an old industrial site near the Alna river, with a train and tube station close to the front entrance. The PV is integrated in the south-facing façade on the back of the building, covering 37% of the school façade area.

The partners involved in the project were: the Educational department in Oslo (placing the order and user of the building), Undervisningsbygg Oslo KF (builder and owner), NCC Norway (entrepreneur and project coordinator), HRTB Arkitekter (architect), Norconsult (advisor for energy and environment), Multiconsult (advisor for design simulation, purchase specifications and quality control of the BIPV façade), Issol (BIPV panel supplier), Staticus (BIPV façade projecting and installation), and Steen Jørgensen (electrical services).

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

Aesthetic integration

The BIPV system is visible from afar, which gives it a demonstration value. Pupils and teachers can follow the power production and consumption in the building, which also gives a pedagogical dimension. A uniform 'non-technical' BIPV façade has been achieved using all-black modules and fastening brackets. All module formats were adapted to the façade to give a holistic architectural impression.

Energy integration

As there is no clear regulation in Norway for the definition of nZEB, it was decided that the building should use 70% less energy than the existing technical standard (TEK10), with net delivered energy below 40 kWh/m^2/yr. To achieve this, a range of energy solutions were implemented including natural lighting, heat pump and 20 energy wells drilled 250 m deep into the ground. The energy consumption for heating and hot water is covered 90% by the heat pump/ground well system, whereas the PV system covers 25% of the electrical consumption. The estimated annual PV production is 105 MWh (633 kWh/kWp). When the school is in use, all PV electricity is consumed. When it is empty during weekends or vacations, power is exported to the grid within the 'plus-customer' limit of 100 kW. Overall self-consumption is expected to be 80-100%.

Technology integration

The modules are of the type ISSOL CENIT220-6112, tailor-made in 26 different sizes adapted to the façade area. The frameless modules consist of standard black mono-crystalline silicon solar cells with black-painted metal wires and busbars, and 4 mm building-approved safety glass at the front and back. The modules are mounted as aired cladding with waterproof insulation at the back, which will dry out in case of moisture intrusion. The BIPV façade fastening method was especially developed for the project by ISSOL and installed by Staticus. They used standard but deeper brackets for façade glass mounting, fastened to the battens of the climate wall, with PV panels hooked onto the brackets. The DC cabling outside is hidden behind the BIPV modules. Inverters are placed inside, distributed in several electrical rooms to reduce DC cable lengths.

Decision making

The BIPV solution was proposed as an idea during the pre-project phase, which is a late stage in the planning process. The initiative to apply a PV system to the building was taken by the owner Undervisningsbygg Oslo KF, a property company owned by Oslo municipality with the responsibility to build and maintain school buildings in Oslo. The order was placed by the Education Department of Oslo municipality, who will also be the rental user of the building. The final decision was made when financial support from the ‘Energy efficient buildings’ program at the public financer Enova was approved in autumn 2014. The school building was already drawn up as a regular building without PV. However, new drawings were made. The PV elements were drawn into the façade as the roof area was not available. The architect desired an integrated architectural expression. At that stage, the involved parties did not know much about different technologies and what they could offer. During the project, it became clear that the PV installation had to adhere to both glass façade standards (using safety glass), as well as electrical and fire safety requirements. The latter were quite unclear.

Lessons learnt

BIPV is still new in Norway, which became apparent during the tender process. There were few reference systems and none of the suppliers had experience with a total delivery of integrated solar cells in façade. The BIPV system was added late in the pre-project, and as a consequence the architect was not able to make all desired adjustments. After the BIPV façade was included, the building was re-designed to place a sportshall on the top of the building which gives some shading on the façade. The main obstacles of this project were costs and unclear regulations. A lot of own effort was used for the coordination and clarification of fastening system specifications and fire safety regulations. The local fire brigade did not have previous knowledge about PV systems, but were happy to receive information and perform an inspection. Important lessons learned include ensuring that the projecting company has sufficient competency, defining regulations and requirements early in the process, knowing who should do the mounting and electrical works, and using clear evaluation criteria for the testing, instrumentation and commissioning of the system. New BIPV projects are now being planned without financial support. This would not have been possible without the knowledge and competency built in this pilot project. The use of standard modules instead of customized sizes and a more efficient process will substantially reduce costs. New offers show that half the cost is possible. The lessons learned are transferred to new projects through the national programme «Futurebuilt» and the research project «Building integrated photovoltaics for Norway».

The local grid company performed an inspection of electrical systems and concluded that a façade installer can mount and connect the PV modules, provided close collaboration with the responsible electrician, a safe-job-analysis, and a sufficiently insulated system with quick-release coupling. The installer had to be registered and deliver a compliance declaration for the projecting work according to the regulation on electrical low voltage systems in Norway. Undervisningsbygg made an operation and maintenance instruction explaining what needs to be taken into consideration with regards to safety.

The PV system was planned within the economic framework of ordinary investment and financial support from Enova. The project would not have been built without Enova funding, which covered the added costs associated with achieving the nZEB goal. Income from the PV system was not a driver for the project. The higher costs were accepted as this was a pilot study. The total cost of the BIPV façade was 792 €/m^2. Compared to a normal brick façade, the additional cost of the BIPV system was 469 €/m^2. If no financial support is included, the net present value of the BIPV system is negative. With financial support and the 'savings' from the replaced brick façade included, the investment is paid back in 20-25 years. The cost distribution was: BIPV modules 29%, inverters and cabling 16%, installation including materials and work 40%, project management 10%, other 5%.

PROJECT DATA

Project type	new construction
Building use	education
Building address	Brynsengfaret 10, Oslo, Norway

BIPV systems

BIPV SYSTEM DATA

Architectural system	rainscreen
Integration year	2017
Active material	monocrystalline silicon
Module transparency	opaque
Module technology	glass-glass, hidden PV, customized modules
System power [kWp]	166
System area [m²]	1,046
Module dimensions [mm]	26 different, from 400 x 664 to 2,760 x 980
Modules orientation	South
Modules tilt [°]	90
Annual FV production [kWh]	105000

BIPV SYSTEM COSTS

Total cost [€]	828000
€/m²	792
€/kWp	5000

Stakeholders

Main building designer

HRTB Arkitekter

BIPV system designer

Multiconsult, Staticus

BIPV components producer

ISSOL
Rue du Progrès 18, Dison (Liège), Belgium
infopv@issol.eu +32 (0)87 71 90 81
http://www.issol.eu/

Collaborators

Norconsult, ?Steen Jørgensen

Red coloured elements were added by the architect to break up the black façade © Undervisningsbygg Oslo KF

Mounting of the BIPV façade modules © Lavenergiprogrammet

Environmental advisor and technical project manager © Undervisningsbygg Oslo KF

Black mounting brackets and modules give the façade a uniform appearance © Lavenergiprogrammet

Details of BIPV module with mounting frame © Sean Erik Foss (IFE)

Front entrance of Brynseng school © Undervisningsbygg Oslo KF

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