SOLAR

A solar façade? The rise of building-integrated photovoltaics in Europe

Building-integrated photovoltaics (BIPVs) – photovoltaic materials that are used to replace conventional materials in parts of a building envelope – are growing increasingly advanced. So why aren't they more common? *Andrew Mourant* takes a look at their growth potential.

If climate change is to be tackled meaningfully, buildings of the future must become far 'smarter' than they are today. But a world in which building-integrated photovoltaics (BIPVs) are commonplace remains far off – even though the case for adopting these technologies could hardly be stronger.

The International Energy Agency (IEA) estimates that just 1%-3% of all installed photovoltaic technologies are building-integrated. Within that niche market, more than 100 product prototypes are available worldwide, though few seem able to cross the valley of death between development and large-scale market rollout.

Slow uptake

Piecemeal development and the perception of high costs are among the main obstacles to BIPV adoption. Another is a lack of understanding about what systems might work best across a broad spectrum of buildings. However, serious efforts have been made to address this knowledge deficit through an EU project in South Tyrol, Italy, which examined 16 different BIPV case studies.

The buildings in the project ranged from churches to office blocks and the integrated technologies included opaque and semi-transparent roofs, as well as warm, cold and double skin façades. Ultimately, the report's key conclusion may act as a spur to developers. The capital costs of building-integrated solar, it found, lie within an 'acceptable' range. This means that they're cheaper than standard 'passive' building materials, such as glazed curtain walls and stone.

Roof-integrated solar modules on a home in Godalming, Surrey
Photo: Viridian

Incentive schemes had played a big part in stimulating the use of BIPV – the 16 South Tyrol case studies were picked from a pool of 40 local examples. A majority – 60% – used integrated BIPV during construction, and the remainder were retrofitted. Façade and roof systems were most commonly employed.

Costs were studied from two perspectives. First was kilowatt-peak (kWp), the rate at which a PV system generates energy at peak performance – for example at noon on a sunny day. The second related to the extent of surface area covered by whichever BIPV features were used. The discovery that capital costs can be cheaper than standard materials may surprise many across the construction industry, despite the recent sharp fall in PV costs which, in turn, has lowered BIPV prices.

'Unfortunately, the market has been driven by financial considerations,' says Chris Coonick, Innovation Lead at the Industrial Strategy Challenge Fund's Transforming Construction Programme at Innovate UK. 'If everyone looked at just the cost basis, BIPV would never happen. Up to now it's been very niche. However with the dawn of digital construction, BIPV is becoming more accessible. As the industry becomes more familiar with it, people may become less scared... quantity surveyors may think there's less faff.'

Coonick cites one case where BIPV was used instead of glass. It proved lighter and so allowed constructors to downgrade their steel specification. 'With using BIPV, it's about realising those things early,' she explains. 'But the problem has been that when a project gets down to quantity surveyor level, it's fallen out of the equation.'

The technology still has other hurdles to overcome, such as aesthetics and flexibility in design. There is also a shortage of tools to integrate PV and building performance and, at present, a lack of proof of long-term reliability. According to Coonick, some companies are now making their name by focusing on the appearance of BIPV.

'The thinking is with the façade and the roof... just let's make it look gorgeous,' she says. She points to Userhuus, a Swiss company that has designed a BIPV roof with components that resemble huge terracotta tiles, and its buildings that incorporate photovoltaic balconies.

European schemes

Last year, under the EU's Horizon 2020 programme, a consortium of 19 European industry and research partners from seven countries met to kick-start the BIPVBOOST

New homes featuring slate roof-integrated solar PV
Photo: Viridian

project. Its aims include cutting manufacturing costs through automation, designing a big range of multifunctional BIPV products and creating advanced standards so BIPV can be widely used.

Across the UK a handful of current BIPV projects involving social housing may seem like baby steps, but bigger ambitions lie behind them. In Wales, housing provider Pobl Group has forged a partnership with the Active Building Centre (ABC) based at Swansea University, established last year with £36mn of government money as part of the Transforming Construction Industrial Challenge.

Working with academic and industrial partners, ABC's goal is to create and prove the case for buildings that produce and store sufficient renewable energy to meet their own needs, or more. Its Active Homes project is a collaboration between Pobl, Neath & Port Talbot Council and Specific, an innovation and knowledge centre led by Swansea University. It also draws in suppliers such as TATA, BIPVCo, Tesla, SO Modular and Ariston.

In Neath, a complex of 16 homes, two and three-bedroom houses and one-bedroom apartments, has been built using various technologies to maximise insulation and energy efficiency. The solar element, said to be a world first, is a coating designed into the south-facing roof created by Newport-based BIPVco. A thin film of flexible cells is infused directly into building envelope substrates of metals such as steel. This saves the time and material involved in mounting a separate panel.

Tenants moved in this September, with eight of the households taking part in a 12-month monitoring scheme. According to Elfed Roberts, Head of Projects for Pobl, the company is already eyeing a much larger project involving 450 homes. However, he admits that the units are more expensive to build than equivalent conventional houses because the project is small scale and innovative. He's also reluctant to predict how much tenants might save on power and heating but claims their bills will be 'significantly less.'

Retrofit of BIPV remains a barely-tapped market, but it is being explored, largely inspired by Dutch innovator Energiesprong. A UK arm of Energiesprong has been established that includes social housing providers, construction companies and the National Energy Foundation. Working with roof panel manufacturer Viridian Solar, it has carried out a retrofit project for Nottingham City Housing which includes the use of integrated solar roof and battery storage.

The project has been running for a year, and the plan is to make a further 155 houses. The BIPV element, making maximum use of the roof area, costs an average £5,000. During the summer the properties were able to export energy.

The contractor was housebuilder Melius Homes. Managing Director Robert Lamb says average yearly heating bills in what were poorly-insulated houses have fallen from around £1250 to £300–£320. 'However they actually pay around £600–£700, including an energy charge as the landlord is recovering some of the cost,' said Lamb.

Viridian Chief Executive Stuart Elmes believes an integrated solar retrofit market could flourish in the private sector if people come to view it as home improvement rather than a money-maker. Arguably, that outlook has already been undermined by the vagaries of feed-in tariffs. 'Retrofit can work if it doesn't rely on capricious government handouts,' says Elmes. 'If you're going to hit targets with energy costs and emissions, solar has to be part of the mix.'

'It makes sense if they can get the volumes up and costs reduced,' he added. 'Then you would break into a virtuous circle without the need for outside help.'

The benchmark for this project is that any house kitted out with BIPV should be able to generate enough energy annually to meet its heating and hot water needs, and to power household appliances.

The Solar Commission (SC) says government should be driving zero-carbon new homes –

through building regulations and by promoting solar PV in construction methods. It should also support large-scale retrofit, starting in the social housing sector.

The SC is therefore calling for a BIPV and construction industry taskforce to be set up. Government, it says, should take a lead, not least by using its purchasing clout, to ensure its offices and commercial buildings are built to be sustainable. Moreover, local authorities should use powers to set higher standards for energy efficiency within building regulations.

IEA wants to stimulate the worldwide market for BIPV across the board – from one-family homes to large-scale application in offices and utility buildings. It is creating a database to help clients and construction professionals develop projects workable projects. It also intends to tease out the selling points and business models for products, weighing up opportunities created by political incentives and new regulations.

One priority is to demonstrate different technologies in 'real life' test facilities, bridging the gap between prototype and large-scale application. Already the IEA is working towards an international framework of BIPV specifications.

When will there be a tipping point in favour of BIPV? There's no shortage of projects and the body of evidence is growing – compellingly in the case of South Tyrol. The products are out there and everyone, from the EU to the IEA, seems to have the best of intentions. Yet, to the onlooker, it still seems incoherent. In the end, the carrot of economics and growing clamour to save the planet may do the trick. ●

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> **Stuart Elmes, Viridian Solar**