The BIPV breakthrough: where and how?

The idea sounds simple: buildings may be made of structural components exposed to the sun, so why not build a PV-generating capability into them? If a PV-enabled building element looks better than a non-PV-enabled one, architects will adopt it and it will fetch a premium. Equally, the electricity it produces has a value that should also be taken into account in the price of the component.

But although 70% of the PV in Europe is installed in buildings (residential, commercial or industrial), this has very largely been in the form of BAPV ("Building-applied photovoltaics"), i.e. mass-produced, efficient, low-cost modules manufactured to standard dimensions.

Consensus on the BIPV early market: façades

BIPV is in search of its killer app. Analysis performed by the European PV Technology Platform1 and presented by Gaëtan Masson (Director of PV consultancy Becquerel Institute) at its conference, Energy Efficiency in Buildings and Building-integrated Photovoltaics: Where Sustainability meets Aesthetics2 has shown that the early markets for BIPV are more likely to be found in glass façades than in roof tiles.
The typical cost of a BIPV glass façade is 220 EUR/m2 façade, while a non-PV double glazing façade may cost 180 EUR/m2. The 40 EUR/m2 difference is greatly exceeded by the income of 175 EUR/m2 that might be generated by PV-façade over 20 years, under reasonable assumptions. With roof tiles, the conventional, non-PV variety cost 50-100 EUR/m2. PV tiles cost 3-9 times more, opening up a difference of 200-400 EUR/m2. The value of produced electricity, at 300 EUR/m2, may not be enough to bridge the gap.

The two other speakers to comment on BIPV's best prospects for near-term growth also tipped PV façades as their choice.

[1] EU PV TP: a group of researchers from industry, academia and research centres advising the European Commission on PV technology policy: www.eupvplatform.org
[2] 8 July 2015 – RIBA (Royal Institute of British Architects), London

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Larry Malcic, Design Principal at the architecture, engineering and urban planning firm HOK, gave two reasons why the BIPV industry ought to work more closely with the curtain wall3 industry, no part of which, so far as he was aware, was "doing anything with PV". Firstly, some curtain walls are made of large, prefabricated elements often produced in standard sizes. "Frankly, they already look like PV panels, so it's a natural fit," he said. Secondly, production is concentrated in "half a dozen players around the world". Malcic is confident that if they took the plunge to manufacture PV-enabled ones, design teams would understand them as familiar components, readily and relatively effortlessly including them in their designs.

Neil Pennell, Head of Engineering and Design at Land Securities, a company that owns, develops and manages offices, shops and housing in the UK, noted a preference among his potential customers for glassy buildings: "They afford daylight, good views and a feeling of space". He identified BIPV as a way to continue to meet this demand while complying with ever more stringent energy performance regulations.

Barriers to BIPV deployment

If the potentials are so self-evident, why have they not been exploited? One reason could be the unsettled question of the relative importance of electricity generation and aesthetic quality in BIPV elements and another, related to the first, is conservatism in the building industry and in the financial community.

Aesthetic appeal

Paul Cartuyvels of the construction company Bouygues underlined the importance of aesthetics: "When I talked to the people in my company, the first thing they said was that BIPV has to be beautiful." The CEO of Issol4, Laurent Quittre said, "The primary objective of a company like mine is to make very beautiful projects. Our customers care about their image. They want beautiful façades and buildings. The second thing they want is a sustainable image – to be associated with companies doing the right thing for the environment. Thirdly, the façade has to work and to produce electricity." But Frédéric Bonnefoy, Product Manager Active Glass at AGC, a large glass manufacturer supplying many

3 Curtain walls: non-load-bearing exterior walls of buildings, sometimes known as a building's 'skin'
4 Issol: a "solar glass manufacturer and a project developer of active glazing solutions" - http://www.issol.eu/en/about-us

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different industries, said, "For us aesthetics is not the main driver of BIPV. [A few stylish buildings] do not constitute a market. The market will only come with affordable, efficient and durable solutions. Return on investment is important."

Conservativism

"There's an inbuilt conservatism in the construction industry," said Pennell. "BAPV has a track record that BIPV does not yet have. Elements that serve an aesthetic function need to prove that they retain their original appearance as well as maintain a decent level of electricity generation." Speaking from the perspective of the UK, he said commercial buildings are valued on the income stream they will produce. "Premature obsolescence, for example in a component on the building, is a risk that reduces a building's value." Attitudes to PV are, however, softening. While there are only "a few instances" to date of the presence of a PV system on a building adding to the building's value when sold, this is becoming more common.

Technology trends

Malcic challenged the BIPV industry to "provide architects with BIPV elements that come in a variety of colours, sizes and types." Jef Poortmans, co-Chair of the BIPV group in EU PV TP, reacted by pointing out that "a balance must be struck between, on the one hand, embracing uniformity in BIPV building elements, which will allow cost reduction through economies of scale in manufacturing; and on the other hand, making available elements in a variety of sizes, forms and colour," which could make them more popular with designers.

New products are appearing that could inspire those designers. Laure-Emmanuelle Perret-Aebi, Section Head at CSEM, presented a film developed by her research centre that can be applied to any crystalline silicon PV module to give it a white appearance. Grown on a micro-structured surface, the film scatters light in the visible part of the spectrum while allowing infrared light to pass to the cells beneath. 10% module efficiency is typical. In the lab, 11.4% was achieved using a module made of HIT cells, which are particularly responsive to infrared light. A company, Solaxess, was created at the start of 2015 to commercialise the technology.

While CSEM made a deliberate choice to work with the "cheap, standard and mature" crystalline silicon platform, and to "touch it as little as possible", other

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companies are betting on OPV (organic photovoltaics) for some of their BIPV products. The glass company AGC, noting that spandrels make up 25-70% of the total surface area of a façade in tall, architecturally significant buildings, and can reach 70-95 degrees Celsius in summer and autumn, considers OPV to be better suited to this widely used building element. It has signed a development agreement to integrate organic PV films from the company Heliatek in its glass.

Merck also promotes OPV technology. It was a proud partner in the EU-funded project ROTROT that successfully demonstrated roll-to-roll manufacturing for OPV modules on flexible substrates like plastic films. Merck produces active material for OPV modules. Its product comes in a range of darker colours: blues, greys, greens and browns. "The production process is very cheap, and lamination is a well-established and standardized process, so the technology definitely has the potential to be cost-effective at some point," said David Müller, Global Head of Strategic Marketing PV at that company. "If you have a 20-storey building, the area of the roof relative to the walls is very small, making BIPV the strongest choice."

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