Gloucester Cathedral in England installed a 38 kW

system atop its roof in 2016. The 150-panel system has reduced the cathedral's energy costs by over

Mypower to find the right balance of capital cost

25%. Gloucester Cathedral also worked with installer

and electricity yield while ensuring the panel design

# History in the making

The urgency of rooftop solar uptake has only been accelerated by the current energy crisis, but the spread of PV to historic and landmarked buildings remains limited. In Europe, historic buildings constructed before 1945 represent at least a quarter of total building stock. To boost uptake, some municipalities are considering a loosening of their protection policies, while researchers are finding interesting byways for installation. Furthermore, building integrated PV solutions are being touted as the ideal compromise between aesthetic continuity and new generation opportunities.

n a letter written in 1860 to friend Harrison Blake, the American philosopher Henry David Thoreau asked the question: "What is the use of a house if you haven't got a tolerable planet to put it on?" Just over 162 years later and that question is more pertinent than ever, and not just for new builds but also for historic and landmarked buildings.

# **Changing mindset**

The world's historic buildings and districts, many of which are protected, find themselves caught between preserving history and surviving in a rapidly changing modern world. In June 2022, a home-



Photo: Gloucester Cathedral

owner in Melbourne, Australia, was ordered to remove their rooftop solar panels due to heritage restrictions which do not allow solar panel installation on the property's primary façade.

Similar frontage restrictions can be found on the statutes of heritage societies the world over. However, according to the Preservation Resource Center of New Orleans in the US, a growing awareness of the climate crisis and extreme weather events is pushing some preservationists to call for more flexibility in the use of rooftop solar on historic buildings.

This changing sentiment is also being seen in the UK where a recent study by WWF and ScottishPower found that installing green technologies could reduce energy bills by up to £1,878 (\$2,250) a year and cut the carbon emissions of a home by more than 95% over the installation's lifetime. The energy crisis, combined with a cost of living crisis and heatwave conditions, means that it is no surprise eBay UK recorded enormous increases in searches for solar panels and solar batteries in June.

This interest is also being seen among historical and landmarked buildings which are increasingly looking to solar to protect themselves from rising energy bills. In February, researchers from the Centre for Doctoral Training in New and Sustainable Photovoltaics (CDT-PV), a consortium of seven universities led by the University of Bath, published a study in the journal Energy Science & Engineering that found installing solar panels atop the UK's Bath Abbey could significantly reduce the carbon footprint of key heritage buildings that are difficult to insulate while also producing enough clean energy to cover 35% of the abbey's usage.

Professor Alison Walker, director of the CDT-PV, told **pv magazine** that it was important for the abbey that the panels be invisible from street level. Walker said they found the roof to be perfectly capable of this, also noting that church buildings are aligned east-west and so ideal for panels on the south. Walker quipped that the Church of England is now "positively evangelical about solar. And it's really quite heartening to see. The policy now

seems to be that unless there is a strong argument against solar then we should consider it."

Ahead of its time, the 1,000-year-old Gloucester Cathedral had a 38 kW solar array installed on its roof in 2016. The 150 panels reduce the cathedral's energy costs by over 25%, and according to installer Mypower, an animated graphic was created to show shifts in shading throughout the day. "This allowed the cathedral to choose the right balance of capital cost and electricity yield whilst ensuring the panel design closely matched the roof, with aesthetics overriding costs." The Dean of Gloucester told *BBC Radio*, "it's a work of art when you can see it."

"It's also very easy to take panels on and off," said Walker, pointing out a key argument for prioritising solar when seeking to improve the sustainability of historic buildings – namely the fact panels are not "inherently part of the building" and the solution is temporary and reversible. "It's increasingly a no-brainer," he said.

Of course, taking each historic building on a case by case basis is one thing, but opening up entire historic districts to solar uptake is another. A 2014 study as part of the EU's "Energy Efficiency for EU Historic Districts' Sustainability" project that looked at the Old Town of Santiago de Compostela in north-western Spain, a UNESCO World Heritage Site, found that even allowing for heritage constraints, "PV production could cover 68% of electric consumption." Despite this, the study's authors reported limited uptake at the time.

A constrictive factor is the desire for absolute aesthetic continuity of façades in historic districts. Thankfully, a mindset change is afoot on this front. In May, the London Borough of Kensington and Chelsea became the first in the UK to give consent for solar installation on historic listed buildings without planning permission.

Similarly, in the US, President Biden's pick to chair the Advisory Council on Historic Preservation, Sara Bronin, argued in Columbia University journal *Preservation*, *Sustainability, and Equity*, that "new provisions could state a preference for installations that are out of public view, but if such placement would render installations ineffective, the provisions could simply require that new equipment be removable without significant damage to historic fabric."

## Not just a façade

A composite of EU Directives designed to reach the building and renovation goals of the European Green Deal, along with the European Commission's May 2022 REPowerEU's Solar Strategy and its rooftop solar mandate, means Europe is now aggressively pursuing solar installation and integration on its buildings. Since the building sector is responsible for 40% of the EU's total primary energy demand and at least a quarter of the EU's total building stock was constructed prior to 1945, there's opportunity for mass solar uptake if the right compromises can be found.

One avenue in this uptake is that of building integrated PV (BIPV). Thanks to BIPV's technological and aesthetic improvements over the last decade, solutions are more accessible and appropriate than ever before. Historical buildings need not sacrifice aesthetic continuity for improved sustainability and lower energy costs.

According to Cristina Polo López, a researcher in the "BIPV Meets History" database project at the University of Applied Sciences and Arts of Southern Switzerland, which advocates for the development of the BIPV value chain, BIPV on historic buildings can help to generate wider acceptance of BIPV as a building material in its own right. "This mentality needs to change," said Polo López. "These are building elements not At least



The historic Doragno Castle – Rovio, Ticino, Switzerland. Transformed from a medieval castle into a private residence, Doragno Castle now boasts a seamless rooftop BIPV system.



Photo: L. Carugo. deltaZERO SA - De Angelis - Mazza Architects



A transparent pane of a BIPV skylight being installed as part of the historic refurbishment of the Chapter House Canopy of St. Andrews Cathedral in Sydney, Australia.

technological elements. This change is happening, but it is necessary that architects and the building industry know what is possible, what is best practice, and what are the products being developed."

One company effecting that change is Spain-based Onyx Solar, which has already installed innovative BIPV solutions on historic buildings across the globe. The company's chief technical officer, Teodosio del Caño, told **pv magazine** that there is a great interest in using BIPV for renovation. "The fact that you can develop new products based on crystalline technology which hide the solar cells makes it easier to employ solar in renovation projects because the glass is going to look like any other material, such as ceramic tile



The modernist Bell Labs facility in Holmdel, New Jersey, is listed on the National Register of Historic Places as well as being the home of the first commercial solar cell and now also the largest BIPV glass skylight in the United States.

BOOTH A8 / LEVEL 2

or stone. That improvement in aesthetic value makes it easier to install BIPV in historical and protected buildings."

This is a significant shift. Onyx Solar's BIPV business was once almost entirely confined to greenfield projects. Now, del Caño says approximately 20% of Onyx's projects are landmark protected. "It's increasing in an exponential manner," said del Caño.

Some markets are pickier and more restrictive than others. But overall, del Caño said that the regulations are clear and a competent and experienced company has little problems negotiating the legal parameters of historic and landmarked buildings. The real question, he suggested, is if the owner is willing to make the project happen.

Importantly, the intense focus on aesthetics in the BIPV sector now means that the "problem" of faades is potentially a thing of the past. "In the last two years," said del Cańo, "façades have become our main product. It used to be skylights and canopies, but now façades are an excellent market. There are now no restrictions on using BIPV on the front of a building."

This progress is worth celebrating, and has in itself created new profiles of aesthetic taste. Onyx's del Caño told pv magazine that there are now two types of clients. One type of client or architect

**CONVERSE ON CONTRACT OF CONTRACT. OF CONTRACT OF CONTRACT OF CONTRACT OF CONTRACT OF CONTRACT OF CONTRACT. OF CONTRACT OF CONTRACT OF CONTRACT OF CONTRACT. OF CONTRACTON OF CONTRACT. OF CONTRACT. OF CONTRACT. OF CONTRACT. OF CONTRACTON OF CONTRACT. OF** once almost entirely confined to greenfield projects. Now, del Caño says approximately 20% of Onyx's projects are landmark protected >>

prefers to hide the cells and mimic other building materials, but, "there is also a type of client that wants to show off their solar cells, they want to show off their sustainability." Blake Matich



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# Build

Building integrated PV (BIPV) has long been touted as the great architectural composite of the 21st century, a highly efficient building material that actually generates electricity at the place of consumption. Technological, economic, and aesthetic issues have thwarted BIPV's rise, but advances in aesthetics and efficiency, as well as increased demand for PV in densely built-up Europe, should mean the next decade is looking bright for BIPV.

# applications & installations



The BIPV market in Europe saw an initial rise with the rest of the PV market between 2009-2011, though the sector followed market falls.



Thanks to the superior irradiation levels and ease of installation, rooftop solutions are projected to continue their dominance. However, as the efficiency of BIPV façades increases there is expected to be a boost in the latter half of the decade.



### BIPV market projections (GW) Residential Non-residential

Non-residential projects are also set to multiply over the course of the decade as public and private institutions seek to meet carbon-neutral goals.



BIPV market projections (GW) Sources: Becquerel Institute Overall, the BIPV market is projected to see significant growth toward 2030.

0.5% **Renovation\* rates** for residential buildings \*Renovation includes "medium" and "deep" renovations with primary energy savings of 30% and more. 2.0% GER RFI FRA SUI ITA ESP Source: European Commission – Photos: Stäubli/ Burkhardt+Partn Adriano Biondo Comprehensive study of building energy renovation activities and the uptake of nearly zero-energy buildings in the EU, Nov 2019/Becquerel Institute 27

The Grosspeter Tower in Basel, witzerland, is a 78-meter tall switzerland, is a 78-meter tan building covered in anthracite-colored elements that look like metal panels but are in fact thin film solar modules. Completed in 2017, the BIPV system generates 250,000 kWh of electricity annually.