Horizon
The EU Research & Innovation Magazine

European Commission

Off the roof: the quest to harness energy from facades

Researchers are going beyond conventional solar panels in a bid to generate heat and electricity from the other external surfaces of buildings.

26 January 2024 - By JACK MCGOVAN

In social housing on the outskirts of the southern Dutch city of Eindhoven, Renske Crone was delighted with an experiment in 2022 involving her apartment: it was outfitted with panels that produced energy from the Sun.

But her new equipment was distinctly different from the solar panels – also known as photovoltaic modules – visible on countless rooftops in Europe and elsewhere. Instead of producing electricity, as photovoltaic modules do, Crone's panels supplied thermal energy and were installed on the facade of the building.

Thermal thrill

The grey panels, coated with aluminium and resembling laminate flooring, took up 15 square metres. As a result of the test, Crone's home and water got heated with renewable power instead of polluting natural gas – even on cloudy days – and energy bills fell.

The 'house is energy-positive, free from gas, with a net-zero energy bill,' said Crone, who has since moved to another home. 'Who doesn't want that?'

The new energy technology emerged from a research project that received EU funding to make use of all buildings' external surfaces rather than just rooftops to generate power. Called Envision, the project ran for five years through September 2022.

The initiative reflects stepped-up EU efforts to reduce buildings' emissions of greenhouse gases as part of the fight against climate change. Buildings account for around 36% of emissions in Europe and are part of an EU renovation wave.

In the EU, roughly half of buildings' facades are unused.

Infrared band

The bands of radiation that reach the Earth's surface from the Sun include visible light, infrared and ultraviolet.

Whereas regular solar panels make use of visible light, those on Crone's home relied on the infrared spectrum and didn't require the external wall to be orientated in any particular direction. Visible light constitutes roughly 43% of solar radiation while infrared accounts for 50%.

Retrofitting homes so they use both visible light and infrared radiation promises big advances in the harnessing of energy from the Sun. Any external walls can be retrofitted with the Envision technology.

'With our panels and photovoltaic cells on the roof, you can have sufficient energy to make the house energy-positive,' said Bart Erich, a research associate in applied physics at Eindhoven University of Technology.

One of the Envision leaders, he said the total surface area of building facades in Europe is roughly the same as that of roofs.

Tangible progress

Using facades to absorb energy from the Sun would bolster Europe's already-expanding solar thermal industry, which grew 12% in 2022.

The thermal panels are coupled to a heat pump. In the case of social housing, where space is relatively limited, making room for the heat pump can involve building a shed outside – as was the case for Crone.

With the further addition of a battery that retains heat, the thermal energy can be stored when there's an excess.

The prices of such facades range from €150 to €500 per square metre, depending on the type, according to Erich, who said the lifespan is typically 30 years and the return on investment seven to 10 years.

During Envision, the researchers conducted laboratory research, built a site at Eindhoven University of Technology to test the idea and ran demonstrations at homes including Crone's.

In 2022, the team was a finalist in the innovation category of the European Sustainable Energy Awards, which recognise projects and people advancing the transition to cleaner energy.

Since Envision ended, the technology has gathered momentum. Erich is the chief technology officer of a spinoff company called Calosol that is commercialising the panels.

IKEA-style DIY

Calosol aims eventually to build 1 200 square metres of panels, a jump from the 250 square metres produced during Envision. In Crone's apartment, the 15 square metres were sufficient to meet all her year-round heating needs, according to Erich.

'In total, the panels produce about the same amount of energy as – or a little bit more than – the house actually uses,' he said.

Because putting the panels in place is currently a complex undertaking, current research is also seeking to make that step a lot easier. The ultimate goal is to make installation akin to IKEA furniture, according to Erich.

'That's where we are – still struggling to get the installations to the point where everybody can install them,' he said.

Solar windows

To help buildings extract every possible bit of energy from the Sun, other EU-funded researchers are exploring the option of transparent solar windows to produce electricity.

This project, called CITYSOLAR, began in December 2020 and is scheduled to run through April 2024.

CITYSOLAR aims to deploy photovoltaic technologies that absorb radiation in both the infrared and ultraviolet spectrum. The researchers are trying to minimise the absorption of visible light because windows need to transmit it to the building's interior and visible light causes panels to take on colour.

But because infrared and ultraviolet light are less efficient at generating electrical energy, a degree of visible light is useful even for solar windows. The trick for the CITYSOLAR researchers is to find the right mix of efficiency, transparency and colour.

Aldo Di Carlo, a professor of nanoelectronics at the University of Rome Tor Vergata who leads the project, cites a greenhouse as an example of where the technology could be especially useful.

Plants mainly need visible light in the red part of the colour spectrum to grow but can do without most other colours. As a result, semi-transparent photovoltaic cells with a red tinge could absorb energy from the Sun while allowing the red visible light through so plants thrive.

Beyond the lab

So far, the technology has been tested only in the lab. A prototype is due to be created in early 2024 at South Denmark University.

The prototype will play a central role in testing the technology for further development on the way to possible eventual commercialisation.

In the longer term, the CITYSOLAR researchers want to make zero-energy buildings as much a reality as possible. That requires the full-scale retrofitting of transparent or semi-transparent surfaces with the technology being developed.

For residential buildings, a further challenge will be figuring out the right efficiency-to-transparency ratio – a task that will require yet more research.

'We need to use our best science to combat climate change and that means researching technologies like transparent solar cells,' Di Carlo said.

Research in this article was funded by the EU's Horizon Programme. The views of the interviewees don't necessarily reflect those of the European Commission. If you liked this article, please consider sharing it on social media.

More info

- Envision
- CITYSOLAR
- EU Cities' Mission
- EU energy research and innovation