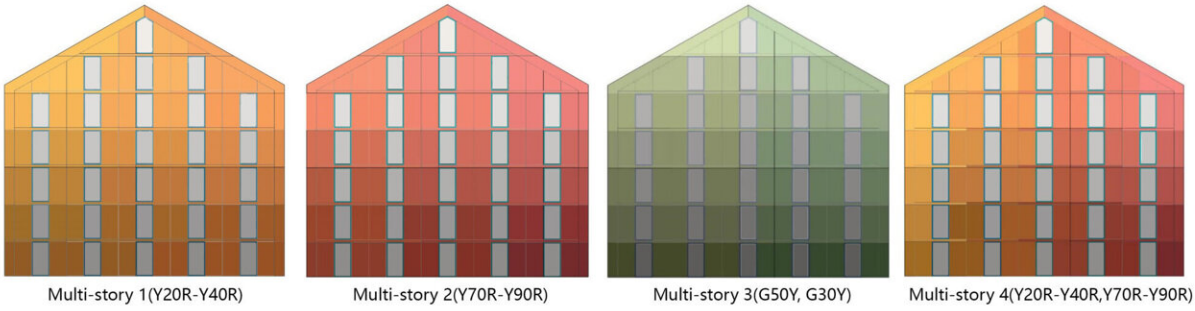
Pixelization of solar panels to beautify building facades

September 20 2022, by Changying Xiang



Different color designs with pixelization method for multi-story houses. Credit: *Solar Energy* (2021). DOI: 10.1016/j.solener.2021.06.079

Buildings consume around one-third of the world's energy and are

responsible for 40% of greenhouse gas emissions. Reducing carbon emissions and using renewable clean energy in buildings are essential to achieve the goals of the carbon neutrality for all of society.

Integrating solar panels into buildings is one of the most promising ways to reduce carbon emissions and support a sustainable future.

Façades should be used for solar panel integration

In the past, most solar panels (photovoltaics) for buildings were installed on roofs, but roof areas can be limited. Building façades offer far more surface area and could be used for this application.

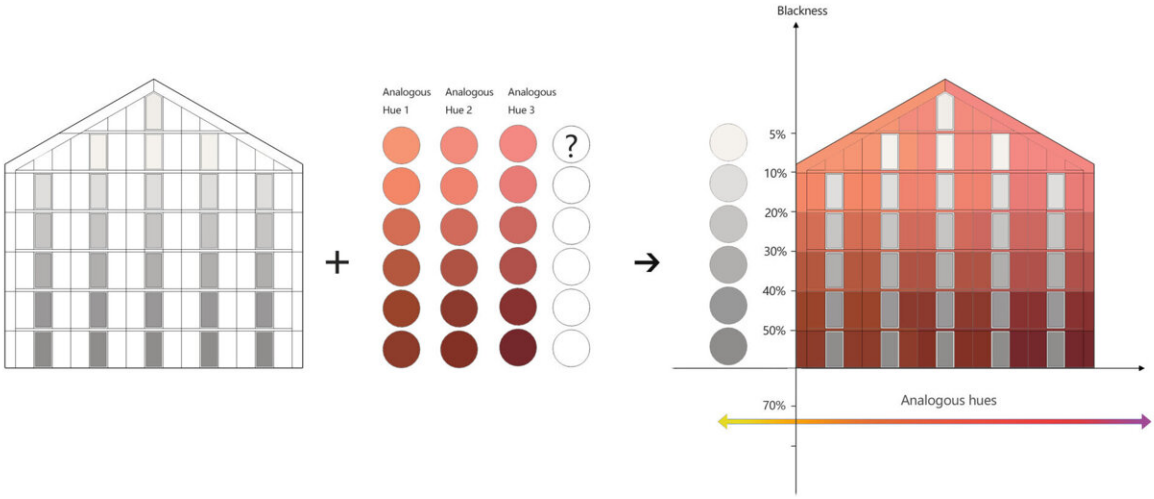
Previous research has shown that façade-integrated photovoltaics (FIPV) are an emerging and essential solution for harvesting solar energy. In Norway, where the sun is usually low, building facades have special potential for the application of solar panels.

Challenges in aesthetics

However, the aesthetic aspect of solar panels can be challenging. The black or dark blue colors of ordinary solar panels are not ideal for building façades, and architects are very much against using boring colors for their designs.

Additionally, Norway is full of colorful houses, many of which are hundreds of years old. The colors of traditional buildings are attractive for tourists and present a beautiful "sense of place" of the local residents.

It's hard to imagine that architects or owners would accept solar panels if it meant all houses had to be black or dark colors.



Here's a conceptualization of the pixelization method that could be used with different color solar panels on a pitch roof façade. Credit: *Solar Energy* (2021). DOI: 10.1016/j.solener.2021.06.079

Pixelization method of design

To solve this issue, a research team (Changying Xiang and professor Barbara Szybinska Matusiak) at NTNU's Light and Color Center have proposed a novel method of equipping building facades with colorful solar panels to producing energy with good efficiency.

Like mosaic pictures or "Neo-Impressionism" artwork, the pixelization method can combine different colored solar panels on the same façade—with smooth color transition in order. In this way, both light color solar panels (usually with lower energy productivity) and dark color solar panels (usually with good energy productivity) in the same or similar hues can be combined, producing acceptable energy productivity

for an overall façade.

The study shows that pixelated colorful solar façades can produce as much as 85%–93% energy compared to a totally black solar façade.

More importantly, the pixelization method can adopt a local color palette—which is a collection of typical colors in local context.

For example, the image below shows typical colors from the city of Trondheim. Architects can ask PV companies to produce the exact color to match existing building facades for solar panels. In this way, the use of pixelization can respect traditional designs while contributing to the colorful "sense of space" of valuable urban spaces.

Satisfying aesthetic performance

The aesthetic performance of the proposed pixelization designs was tested through an international online survey of more than 300 participants with different backgrounds from Norway, Denmark, China, Poland, Netherlands, Italy, Australia, U.S., Japan, and Brazil.

The survey shows that designs with the pixelization method are preferred by the majority, and they are perceived as being more pleasant than non-pixelated ordinary color designs. In addition, most of the participants believed the designs using local colors were appropriate in an urban context.

Photo of the high-rise apartment. Credit: Changying Xiang

Renovation proposal of high-rise apartment with colored photovoltaics on facades. Credit: Changying Xiang

Good energy productivity

Another case study in Trondheim was also conducted, where the pixelization method was used in small are with three high-rise residential apartments.

A colorful renovation design for the high-rise apartment was created, where the energy productivity of the colorful solar façade would be around 80% of a black solar façade. The electricity produced by the colorful solar façade can cover around 26% of the total household energy consumption for these residences.

This research provides novel solutions and design references for applying colored photovoltaics in urban contexts on large scales. The researchers believe that façade-integrated photovoltaics will provide a useful approach to tackle climate changes and achieving a carbon-neutral society.

More information: Tailored Architectural Design Method for Coloured Façade Integrated Photovoltaics: An Example from the Nordic Built Environment

Changying Xiang et al, Pixelization approach for façade integrated coloured photovoltaics-with architectural proposals in city context of Trondheim, Norway, *Solar Energy* (2021). DOI: 10.1016/j.solener.2021.06.079

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