



New BIPV façades featuring crystalline silicon, organic PV modules and CIGS thin-film technology – developed as part of the “Standard-BIPV” project.

### Standardizing BIPV modules

Standardizing BIPV modules facilitates efficient construction and manufacturing processes. Fraunhofer ISE is developing standardized and prefabricated modular BIPV façades that can easily be installed in many different types of buildings, as part of its “Standard-BIPV-System” project.

Since these modular façades have a standard design, the product information can be factored into the building design process right from the very start. This design process is also made easier by the fact that the electrical system configurations are also predefined and standardized. In many cases, solar construction products have to be adapted to meet customers’ requirements. However, even when producing customized solutions, there are ways to use automation and digitalization to significantly cut costs and simplify the design process. At Fraunhofer ISE, we are cooperating with industrial partners to develop automated design and manufacturing solutions for customized BIPV modules with type approval.

Building-integrated PV and its role in the energy transition  
Fraunhofer ISE is working together with industrial partners on a number of flagship BIPV projects. At our “Module-TEC – Module Technology Evaluation Center” we are producing different samples and prototype batches using our own industrial facilities. In our TestLabs for “Solar Façades” and “PV Modules”, which are accredited according to DIN EN ISO 17025, we test the electrical, thermal and optical properties of multifunctional BIPV construction components, as well as the quality and reliability of these modules and systems.



Title image: Colored solar module with MorphoColor® coating.

### Contact

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### Integrated Photovoltaics

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# Building-Integrated Colored Solar Modules

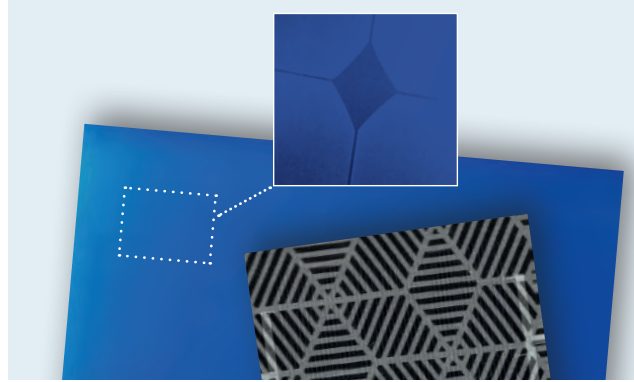
# Building-Integrated Colored Solar Modules

Buildings are major energy consumers and emitters of greenhouse gases. Building-integrated photovoltaics (BIPV) is able to significantly reduce a building's CO<sub>2</sub> footprint and even turn it into a zero-energy or energy-plus building.

The technical potential of BIPV in Germany is at least 1000 GWP – enough to cover a considerable proportion of the country's energy demand without having to dedicate any additional land to energy production. And that's not all: As well as generating electricity, BIPV modules also provide structural, constructional or architectural functions in a building. This multifunctionality makes them a better financial and ecological investment than conventional construction components.

## Our BIPV Development Services

- support with product design
- prototype manufacturing
- technology transfer for production lines
- efficiency analysis and optimization
- yield simulation and monitoring
- cost analysis
- module testing in accredited laboratories
- evaluation of compliance with construction industry regulations
- development and upscaling of processes in conjunction with architects, construction firms, module and component manufacturers and glazing companies



Sample design for a MorphoColor® BIPV module and a SEFAR BIPV module with laminated textile web.

BIPV products can be used almost anywhere on a building, from the roof to the façades, on surfaces that are transparent and those that are not. As such, they open up a host of design possibilities. The BIPV modules from Fraunhofer ISE, for instance, come in many different colors and designs, making them an exciting option for building planners.

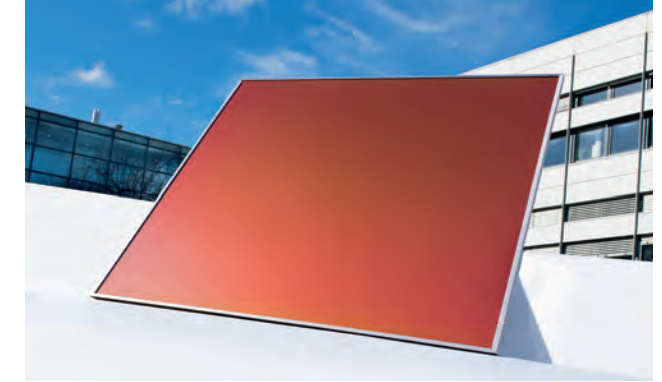
### BIPV developments at Fraunhofer ISE

BIPV modules are available in a wide variety of sizes, shapes, colors and designs, giving architects enormous design freedom. At Fraunhofer ISE, we use an extensive range of materials and technologies to develop module configurations that are efficient and also look great. For each customized, multifunctional BIPV module, we consider:

- the basic technology for the PV cells and their electrical connections e.g. shingle or multi-wire connection
- the optimal function for the structure/construction of the building
- the type of building integration
- the function and color of the glass cover

### Vivid color options thanks to MorphoColor®

Colored PV modules can really inspire a building's architecture and give it an eye-catching and modern appearance. At Fraunhofer ISE, we are working together with our industrial partners to bring our MorphoColor® coating technology to the market.



Colored solar module with MorphoColor® coating.

With MorphoColor®, architects and building designers can select their colors and so enjoy plenty of design freedom:

- strong saturated colors with matte or metallic finish
- good color stability for different viewing angles
- reduced glare

The MorphoColor® coating is a photonic 3D structure made of dielectric materials, which was inspired by morpho butterflies. The coating has a special layered design, resulting in very high color saturation and exceptional color stability for different viewing angles. The solar cell technology underneath the colored coating remains completely hidden from view.

The exceptional efficiency of our MorphoColor® modules is unmatched in the construction sector. Compared to modules of the same type with no coating, the drop in electrical energy generated is only approx. 7%<sub>rel.</sub>

### Market opportunities for European module manufacturers and suppliers

Global competition, particularly in the conventional solar module market, is huge. However, in the case of PV modules for customized applications, local industry is still able to compete. Solutions for individual requirements and design needs can be developed for specific projects and these BIPV modules are then produced in small series.