

SCHWEIZER PHOTOVOLTAIK-TAGUNG 2025





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COLORATION TECHNOLOGIES FOR BUILDING-INTEGRATED PHOTOVOLTAIC MODULES: AN OVERVIEW

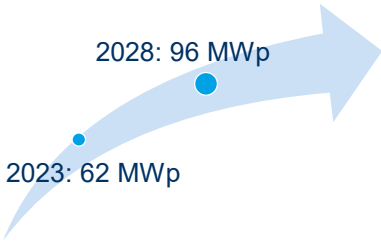
2 avril 2025



LA SUISSE ET L'ESTHÉTIQUE





> 8% of the distributed market was integrated in 2024 in Switzerland*

Expected BIPV growth in CH**:




2028: 96 MWp

2023: 62 MWp

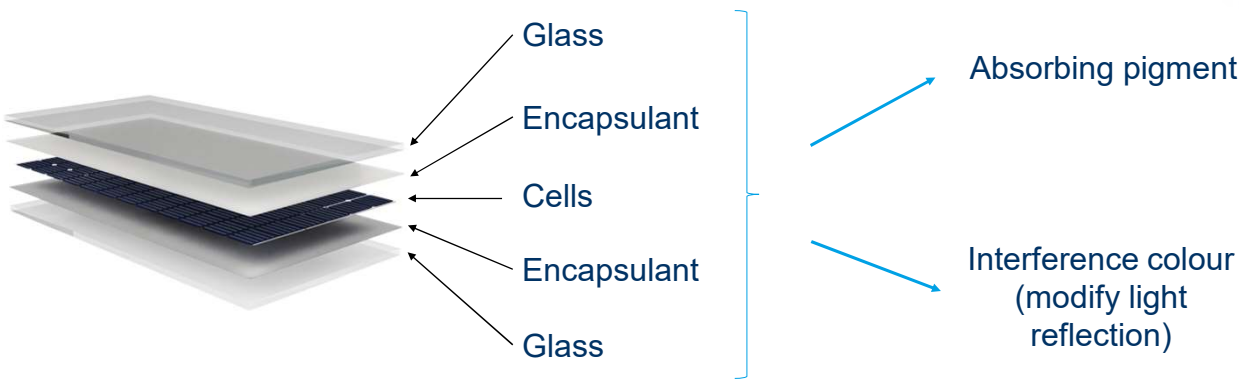


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*pronovo.ch / ** BIPV, A practical handbook for solar buildings' stakeholders, SUPSI, 2024



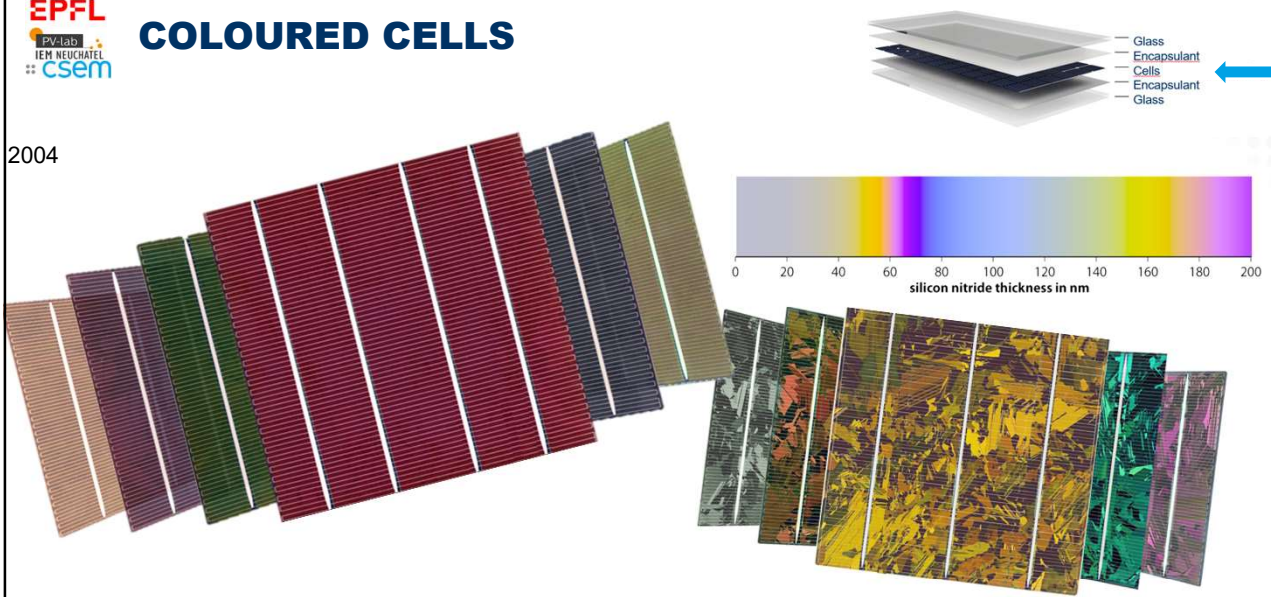
HOW CAN WE BRING COLOURS IN MODULES?



PV-lab
ITEM NEUCHÂTEL
csem

COLOURED CELLS

2004



Coloured crystalline Si cells by playing on antireflection coating thickness

EPFL

PV-lab

IEM NEUCHÂTEL

csem

COLOURED FOILS

SOLAXESS

WHITE & COLOR SOLAR TECHNOLOGY

Glass

Encapsulant

Cells

Encapsulant

Glass



Urdorf



Genève

Selective diffusion filter for infrared light and nanotechnological film to reflect light

csem

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EPFL

PV-lab

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csem

COLOURED FOILS

SOLAXESS

WHITE & COLOR SOLAR TECHNOLOGY

Glass

Encapsulant

Cells

Encapsulant

Glass

3S




Zürich



La Chaux-de-fonds


csem

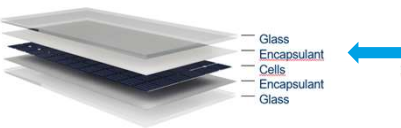
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IEM NEUCHÂTEL
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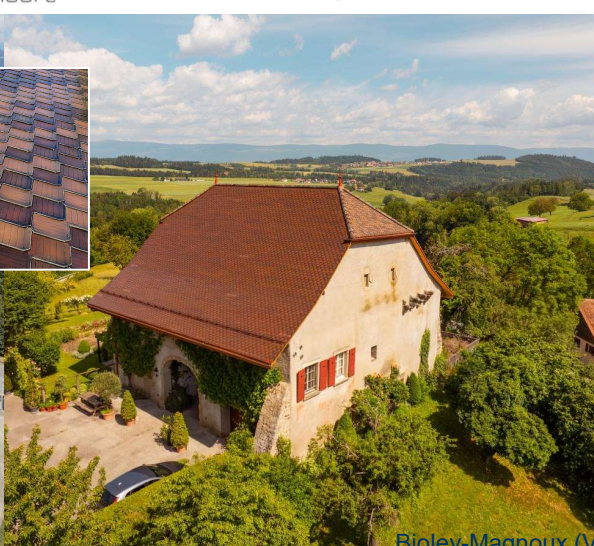
COLOURED FOILS







Ferlens (VD)



Biolley-Magnoux (VD)



EPFL
PV-lab
IEN NEUCHÂTEL
csem

COLOURED FOILS - ART

Compáz (CH) 







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EPFL
 PV-Lab
 IEM NEUCHÂTEL
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COLOURED GLASS

— Glass
 — Encapsulant
 — Cells
 — Encapsulant
 — Glass

Spreitenbach, CH

Genk, BE

Middelburg, NL

glaströsch HSLU Hochschule Luzern

KameleonSolar

with a touch of
soltech

3S Swiss Solar Solutions

Digital Ceramic Printing(DCP)

csem

EPFL

PV-lab

ITEM NEUCHÂTEL

csem

COLOURED GLASS

←

Glass

Encapsulant

Cells

Encapsulant

Glass

INTERFERENCE COLOR

MERCK

Ceramic Colors Wolbring

Special colored pastes for screen printing with mica flakes coated with a thin layer of titanium dioxide (photonic pigments)

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ITEM NEUCHÂTEL

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COLOURED GLASS

←

Glass

Encapsulant

Cells

Encapsulant

Glass

INTERFERENCE COLOR

Kromatix™

Amsterdam

Lausanne




Copenhagen, DK

Nanotechnological surface treatments

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COST: PV AS CONSTRUCTION ELEMENT

BIPV = combining functionalities

Cover

Energy production

COST = BIPV element – cover material being replaced – electricity production - subsidies

STONG RELATION TO POLICIES

Is it cost effective?


- Yes it can be!

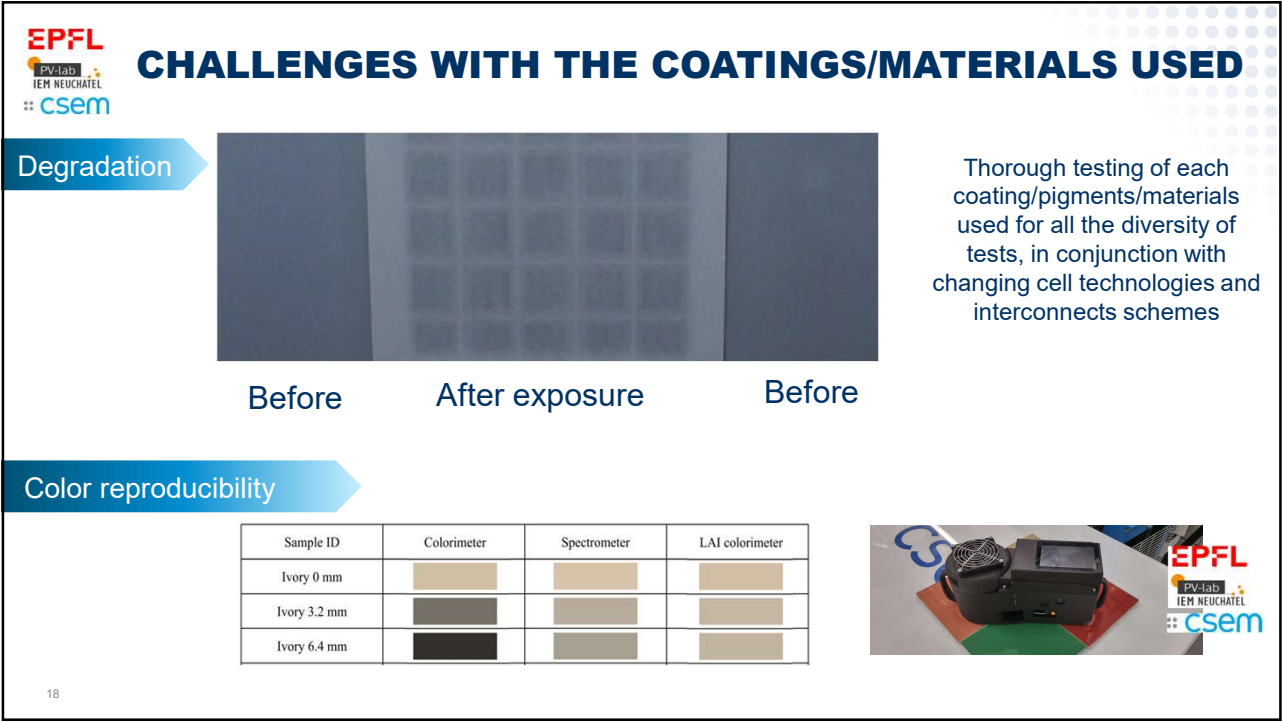
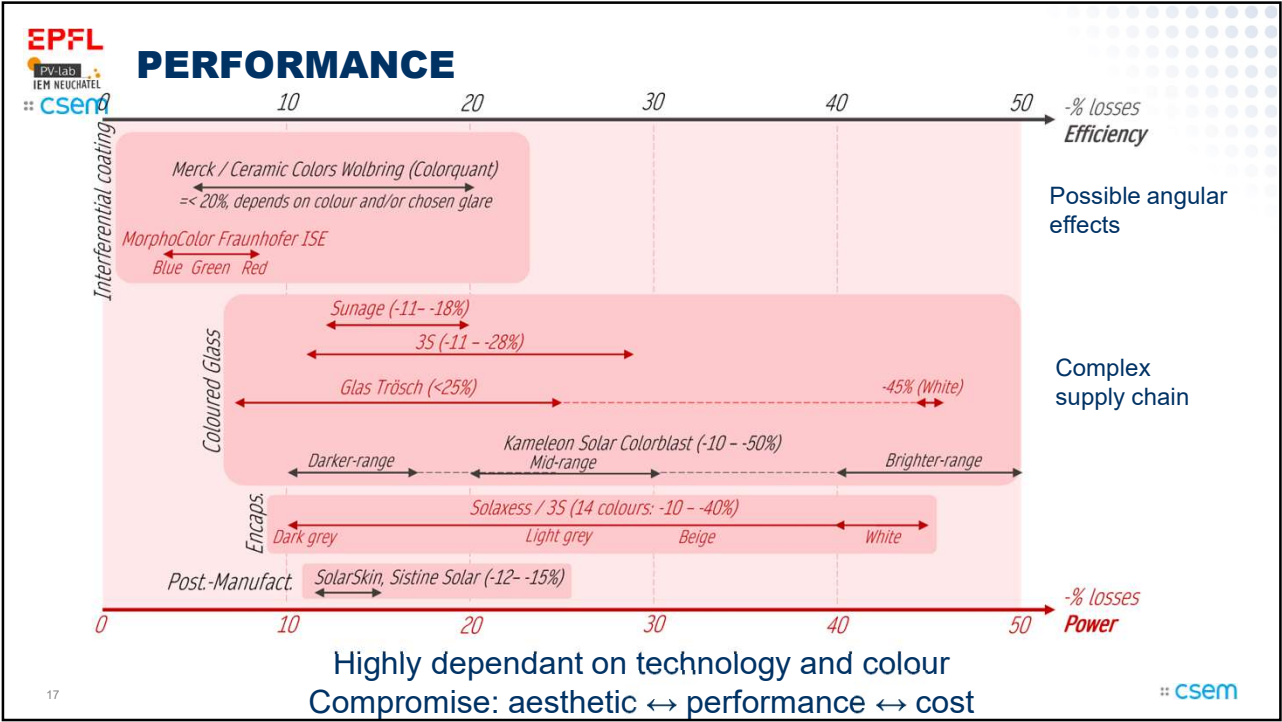
Is it reducing the carbon footprint ?


- Yes, it is in many cases, even north façades!

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The carbon intensity of integrated photovoltaics A Virtuari, Joule 7 (11), 2511-2536 (2024)

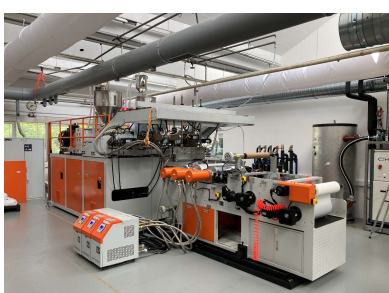









RELIABILITY TESTING + IMPROVING

Example of **CSEM Platform** with extrusion line for custom polymer, module manufacturing and heavy testing infrastructure for modules and colored modules

Reliability challenges should be taken seriously !

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COLOURING TECHNIQUES FOR PV: CONCLUSION

- Revolution in transformative Photovoltaics in the last 10 years
- Replacing inactive construction elements by active elements
- Multiple solutions, products and companies active - each approach has pro and cons
- A chance for keeping niche markets activities in EU with growth potential



A. Borja Block et al., “**Colouring solutions for building integrated photovoltaic modules: A review,**” Energy and Buildings, vol. 314. Elsevier BV, p. 114253, Jul. 2024. doi: 10.1016/j.enbuild.2024.114253.

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Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra



Seamless-PV

Bundesamt für Energie BFE
Office fédéral de l'énergie OFEN



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FACING THE CHALLENGES OF OUR TIME

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Colouring techniques for PV

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- [02] Figure from: HZB Home https://www.helmholtz-berlin.de/projects/baip/bipv_en.html
- [03] Building in Zürich, Switzerland, with terracotta foil. 3S Swiss Solar Solutions AG
- [04] Test installation of MegaSlate Flair DCP coloured modules in Bern with a varied range of colours. Image courtesy of 3S Swiss Solar Solutions AG.
- [05] SUM prototype from Kameleon Solar. (A) Façade. (B) Close-up of the small spaced out DCP hexagons. (C) Full façade. Images provided by Kameleon Solar, Team SUM
- [06] A portfolio of Colorquant product samples from Ceramic Colors Wolbring. Image provided by Ceramic Colors Wolbring GmbH
- [07] Building in Zürich, Switzerland, with terracotta foil. Images provided 3S Swiss Solar Solutions AG
- [08] Freesuns project in Ferlens, Switzerland, with different tones of terra cotta solar tiles. (A) Distant perspective. (B) Near perspective. (C) Close-up view. Images courtesy of Freesuns
- [09] Solaxess
- [10] Computer Science Building of the University of Belfast with Vanceva coloured foils. (A) Main entrance. (B) Façade. Images courtesy of Vanceva
- [11] Project for DEWA R & D from Onyx solar employing see-through coloured a-Si. Image provided by Onyx solar
- [12] First building equipped with Kromatix technology at EPFL main campus. Images courtesy of Kromatix™ SA
- [13] Iconic BIPV building of the Copenhagen International School with blue green Kromatix glass. Images courtesy of Kromatix™ SA
- [14] Morphocolor Fraunhofer ISE
- [15] BIPV building made with a Solaxess nanotechnology white film. Image courtesy of Solaxess
- [16] LOFSolar
- [17] LOFSolar
- [18] Murdoch University Greenhouse with ClearVuePV windows. Images courtesy of ClearVuePV
- [19] Explanatory schematic - ClearVuePV LSC transparent window. Images courtesy of ClearVuePV
- [20] Sistine Solar projects. La Monarch mural and Solar flower at Southeast New Mexico College. Images provided by Sistine Solar
- [21] Examples of realizations using coloured PV modules by Comp'az. Images courtesy of Association Comp'az
- [22] A. Borja Block et al., "Colouring solutions for building integrated photovoltaic modules: A review," Energy and Buildings, vol. 314. Elsevier BV, p. 114253, Jul. 2024. doi: 10.1016/j.enbuild.2024.114253.
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