

Cost-effective and innovative solar energy integration in stock and new buildings
- how to generate revenue with your building façade and roof

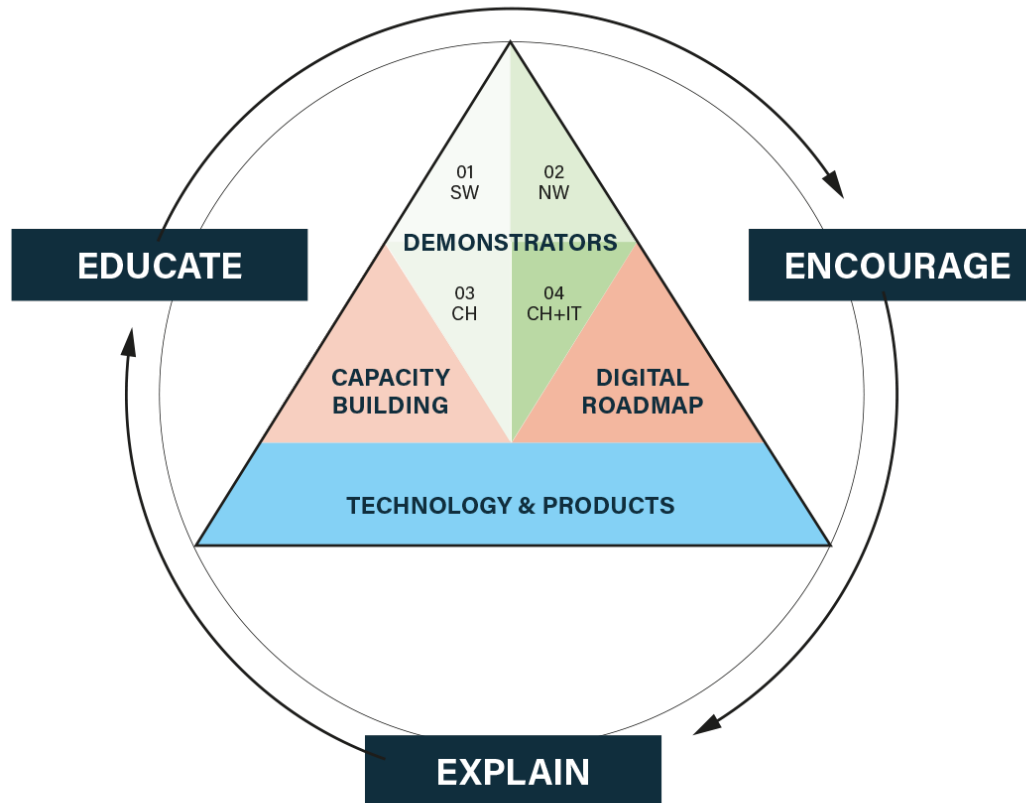
Commercial Solutions for the building sector – how to implement them in a big scale.

Laure-Emmanuelle Perret
Be-Smart project coordinator

The logo for EPFL, consisting of the letters 'EPFL' in a bold, red, sans-serif font.

Let's Be-Smart together

01 - UPPSALA / SW
 02 - OSLO / NW
 03 - NEUCHATEL / CH
 04 - WATT IS ART / CHINA + CH + IT



WP4 Demonstrator buildings

WP7 Communication & Dissemination

WP6 Exploitation and capacity building or BIPV implementation in Europe

WP2 Multifunctional EPoGs

WP3 Multifunctional performance, lifetime, reliability, upscaling and monitoring

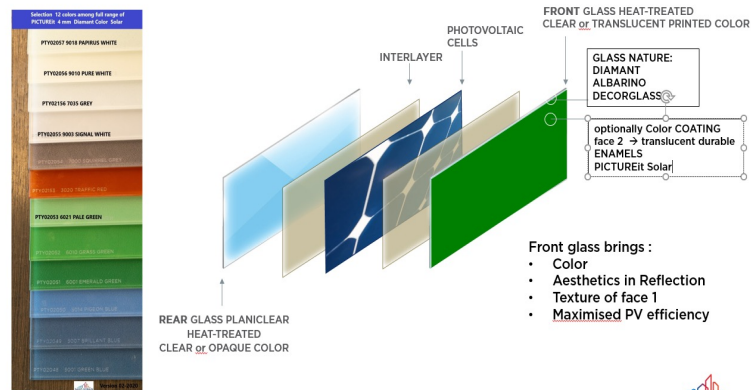
WP1 Project management

Technology and Products

Coloured glass for EPoGs by Digital ceramic printing

Main contributors: SGDE, WHITE, CEA, CSEM

COLOR EPOG & PV GLAZING – PRODUCT DESIGN



Front glass brings :

- Color
- Aesthetics in Reflection
- Texture of face 1
- Maximised PV efficiency



Coloured encapsulants for EPoGs

Main contributors: CSEM, PADA, SOLAX



- PICTUREit Solar series for the use of EPoG, composed of 184 colors including 10 target colours were developed;
- New ink and printing processes were optimized for EPoGs;
- Reliability performances were evaluated in WP3



Technology and Products

Optimization of clear encapsulant for EPoG

Main contributors: PADA, CSEM



- no peroxide reaction to be activated
- time and energy saving
- high and stable adhesion on silica substrates
- no acidity evolved along PV module lifetime
- very low content of impurities
- high stability to weathering and low water absorption and transmission
- effective barrier against PID-d
- suitable for temperature sensitive cells

Polidienne® Solar Film

Technology and Products

EPoG color modelling and power prediction

Main contributors: CSEM

Select a pigment mixture and the thickness of the colored layer → Optical model based on 4 flux theory and Mie scattering. Pigments are defined by its refractive index data (n,k) and its size distribution.

Reflectance curve for the reference color selected and the calculated color layer

Comparison of the EQE of a module without colored layer (Ref) and the expected EQE of the module with the calculated color layer.

Possibility to load reflectance curves measured for different reference colors

Possibility to load experimental data for comparing with calculated data

Table summarizing color differences (ΔE) and performance differences (ΔJ_{sc}) between color reference, calculated color modules and measured color modules.

Table summarizing the mixture and thickness used in the calculated color layers and for the experimental modules.

Lab color coordinates for the reference, calculated color layers and experimental data. Display of an RGB color approximation.

Short circuit current of the reference module and the estimated value for the calculated color modules.

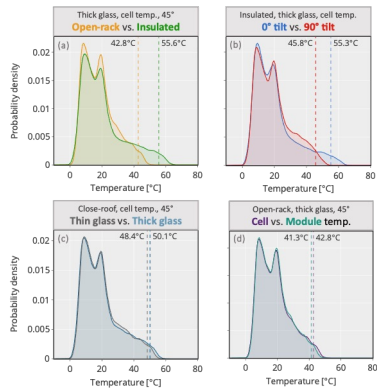
RAL	Diffuser	Model: Type A			Resulting Color			Losses [%]
		R	G	B	L	a	b	
8004	Standard	255	63	75	<u>42.8</u>	<u>22.3</u>	<u>19.2</u>	<u>40.8</u>
3012	Standard	255	105	100	<u>56.6</u>	<u>21.4</u>	<u>19.0</u>	<u>47.4</u>
1013	Standard	255	210	182.5	<u>75.8</u>	<u>0.6</u>	<u>8.8</u>	<u>43.6</u>
1036	Standard	255	170	120	<u>64.6</u>	<u>4.5</u>	<u>22.3</u>	<u>41.1</u>

RAL	Model: Type B			Resulting Color			Losses [%]
	R	G	B	L	a	b	
9017	255	255	255	<u>23.6</u>	<u>0.5</u>	<u>-0.1</u>	<u>0.0</u>
6009	255	243	125	<u>30.3</u>	<u>-5.0</u>	<u>2.3</u>	<u>6.1</u>
7043	255	220	198	<u>40.6</u>	<u>-1.8</u>	<u>-1.5</u>	<u>10.7</u>
5020	30	255	210	<u>36.7</u>	<u>-12.8</u>	<u>-10.5</u>	<u>26.2</u>
3009	255	0	71	<u>35.5</u>	<u>19.2</u>	<u>11.0</u>	<u>41.5</u>
8004	255	63	71	<u>43.9</u>	<u>22.4</u>	<u>19.9</u>	<u>53.4</u>

Multifunctional and multi-scale performances

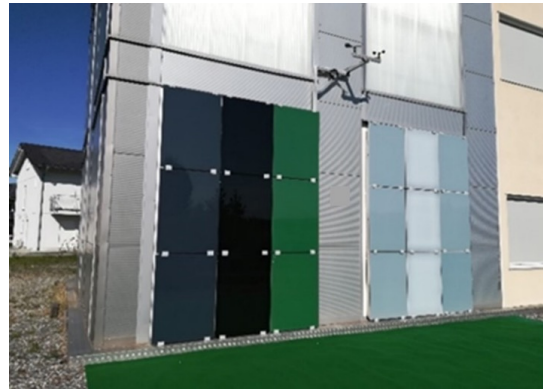
1-cell mini-modules

Main contributors: EPFL, CEA, IFE



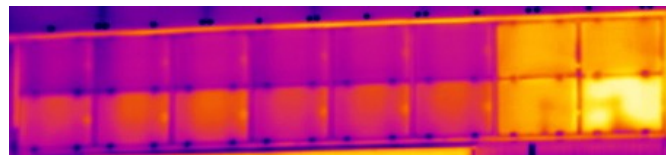
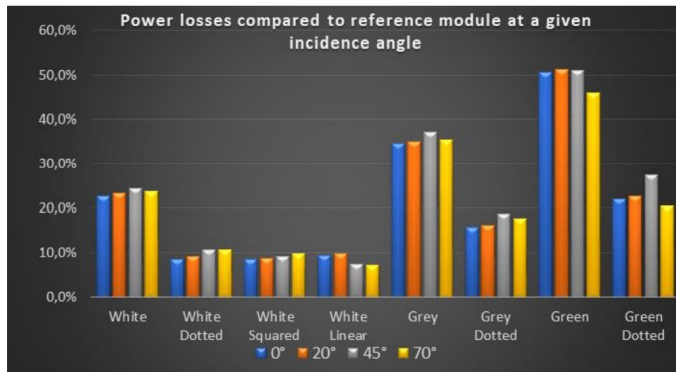
Prototype EPoG modules

Main contributors: IFE, CEA, SGDE



Full EPoG system demonstrator:

Main contributors: CEA, IFE



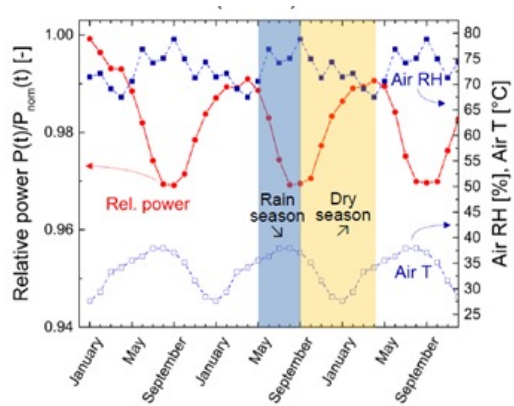
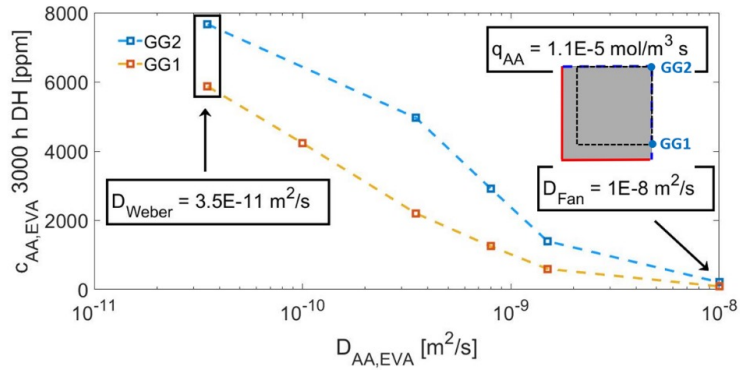
- Minimal recommended locations of thermocouples at the PV modules rear side if their number has to be limited.
- Weather station location



NO

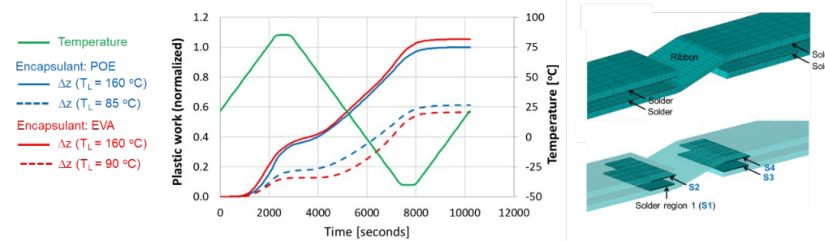
Reliability model

Moisture ingress and PID Main contributors: EPFL

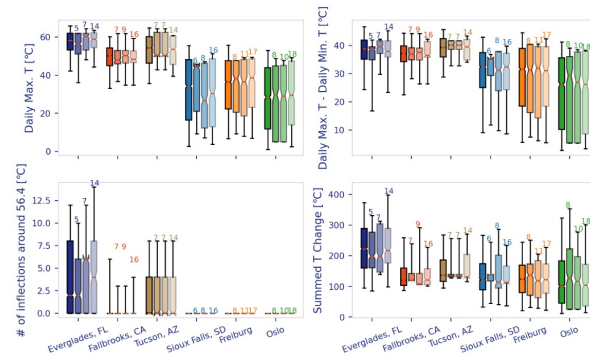


20/04/2023

Thermomechanical fatigue and solder joint Main contributors: IFE



Predictive models using representative days Main contributors: IFE



Mechanical load Main contributors: CSEM

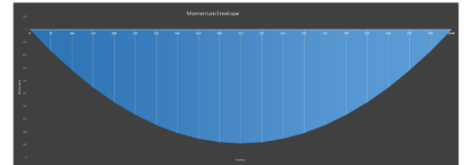
Building
 Ground category: urban area
 N. floor: 7
 Wind pressure: 1.47kN/m²

EpoG
 Size (a x b): 0.72m x 2.925m
 1.040 x 2.925m
 Front glass: 4mm
 Back glass: 4mm
 Encapsulant: POE 2x0.450mm
 Module temperature: 90°C

Fixation system
 Fixed at both long sides (Schüco AOC 60 TI)

Design value
 $W_g = 20\text{mm}$ $f_{g,d} = 87 \text{ N/mm}^2$

$Q_{sLS} = 1.5 \text{ kN/m}^2$ $Q_{uLS} = 2.25 \text{ kN/m}^2$
 $G^* = 0.3 \text{ Mpa}$ $f = 0.36$ $h_{ef,w} = 6.37\text{mm}$ $h_{ef,c} = 6.96\text{mm}$



	EPoG1	EPoG2
W_{max}	4.6mm	15.2mm
σ_{max}	21N/mm ²	38N/mm ²



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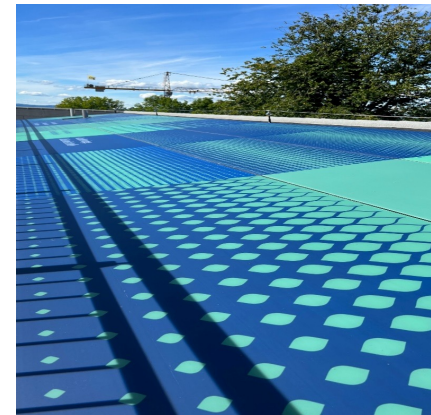
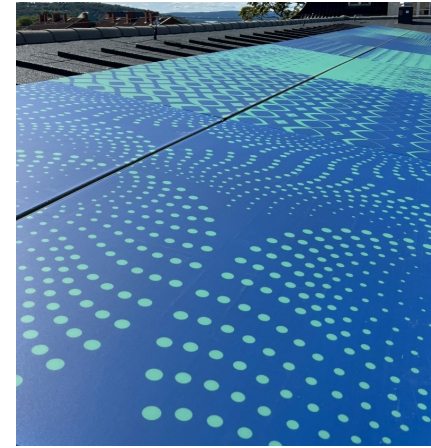
How to implement?

The contribution of Be-Smart.

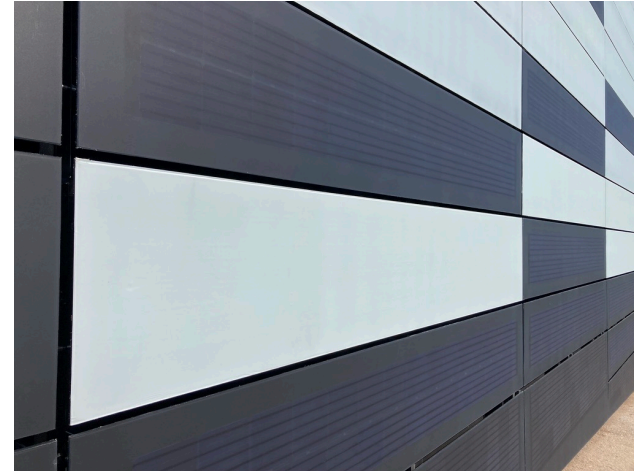
Magasin X, Uppsala, Sweden



Queen Ingrid's Garden Oslo, Norway



Marin Centre – Migros, Neuchâtel, Switzerland



Figli del Sole, Oliveri, Sicily



Film of the project

What have been the different demonstrators linked to the Be-Smart project, and the project itself?

We have been following the consortium activities and working on a film condensing the four years of activity of this magnificent human and technological adventure that Be-Smart is.

[See more videos related to the project on our YouTube channel](#)



Educational programme online

The screenshot shows the BE SMART website's 'Training' page. At the top right, there are navigation links for 'Contact', 'ABOUT', 'DEMONSTRATORS', and 'BLOG'. The main heading is 'Training'. Below it is a welcome message and a paragraph explaining the online learning experience. A table lists four modules with their titles and durations. At the bottom left, there is a green button labeled 'OVERVIEW (PDF)'. On the right side of the page, there is a photograph of a man and a woman looking at a white architectural model of a building on a desk.

BE SMART [Contact](#)

[ABOUT](#) [DEMONSTRATORS](#) [BLOG](#)

Training

Welcome to the Capacity Building Programme of the Be-Smart project!

We have created this online learning experience so you can access different content related to the BIPV technology and EPoG elements at your own pace. All the information has been divided into four modules and you can decide which one adjust best to your professional ambitions and interests.

Overview	Duration
Module 1 The Be-Smart Project: an overview	134 minutes
Module 2 The BIPV Technology - Technical aspects	450 minutes
Module 3 The BIPV Technology - Assessments & Evaluation	240 minutes
Module 4 The BIPV Technology - Trends, prospects & funding opportunities	240 minutes

[OVERVIEW \(PDF\)](#)



Our roadmap

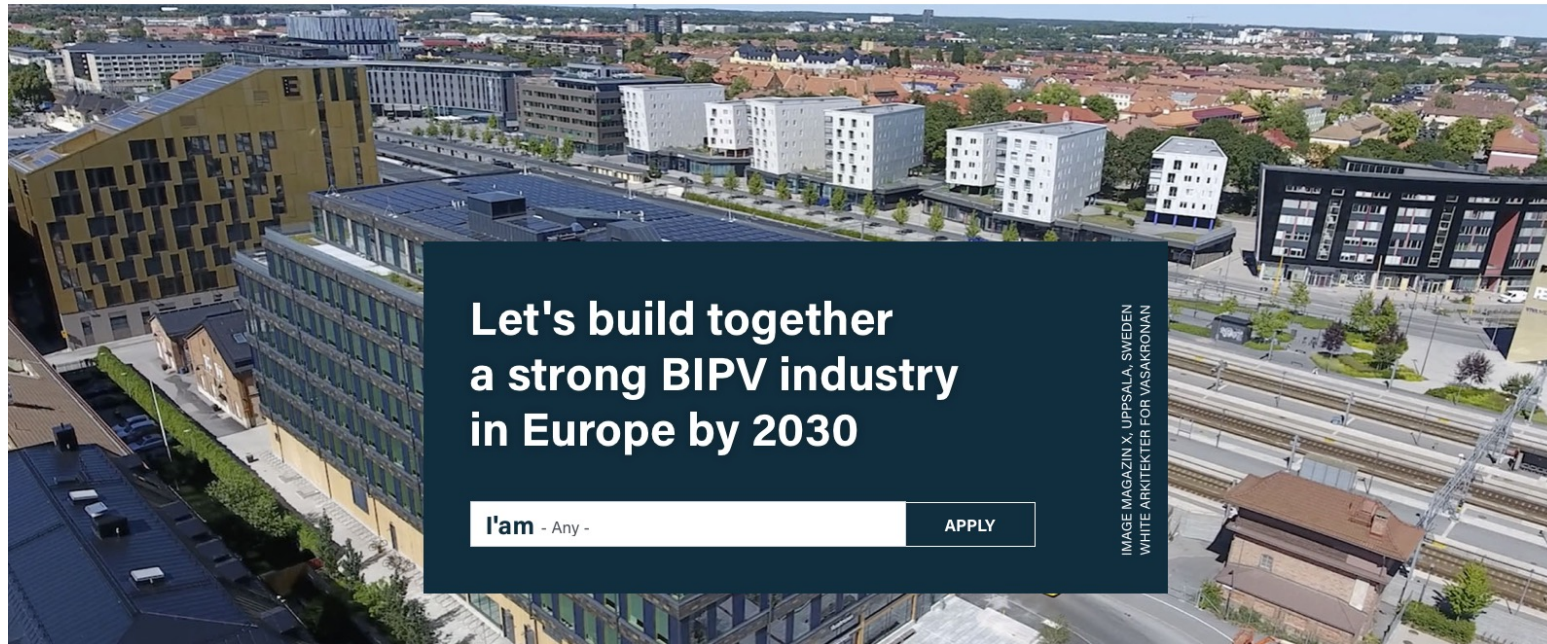
The Be-Smart consortium is a group of engaged, committed and passionate experts who have joined forces to develop a roadmap that will contribute to enable the massive implementation and use of BIPV elements in the building industry.

This solution-oriented roadmap aims at inspiring and connecting anyone active in the field to promote their specific actions and field of expertise and engage them to contribute actively to the European green deal goals.

We believe that BIPV elements are key to more sustainable buildings and that by working together, we can make a real difference.

Join us on this journey!

<https://www.besmartproject.eu/roadmap>



Thank you

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The information reflects only the project's view and the Commission is not responsible for any use that may be made of the information it contains.