

# BIPV cost competitiveness and future developments in Europe

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As part of the BIPVBOOST project  
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BECQUEREL  
INSTITUTE

# Becquerel Institute at a glance



- Est. 2014 in **Brussels, Belgium**
- Est. 2022 in **France**
- Focused on **solar PV and its related ecosystems** (storage, electro mobility, buildings)



## Project Developers



## Manufacturers



## Associations



## Research projects



# Table of Contents

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- 1** | What is BIPV competitiveness
- 2** | BIPV competitiveness status in Europe
- 3** | Innovations & perspectives for improvement
- 4** | BIPV competitiveness outlook & main influencing factors
- 5** | Key takeaways

# Table of Contents

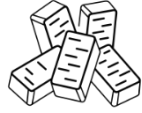
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- 1** | **What is BIPV competitiveness**
- 2** | BIPV competitiveness status in Europe
- 3** | Innovations & perspectives for improvement
- 4** | BIPV competitiveness outlook & main influencing factors
- 5** | Key takeaways

## 1 | What is BIPV competitiveness

As building-integrated PV components and systems serve multiple functions, their competitiveness can be evaluated from various perspectives

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1) As a construction component

**Metric for the comparison:** €/m<sup>2</sup>

**Comparison point:** conventional construction materials such as ceramic tiles, concrete, glass, ...



2) As a construction system

**Metric for the comparison:** €/m<sup>2</sup>

**Comparison point:** conventional construction systems such as ceramic tiles roofs, concrete facades, glass facades, ...



3) As an electricity generation unit

**Metric for the comparison:** €/kWh

**Comparison point:** other electricity generating units such as BAPV, retail or wholesale electricity prices, ...



4) As a project (“holistic” or “TCO” approach)

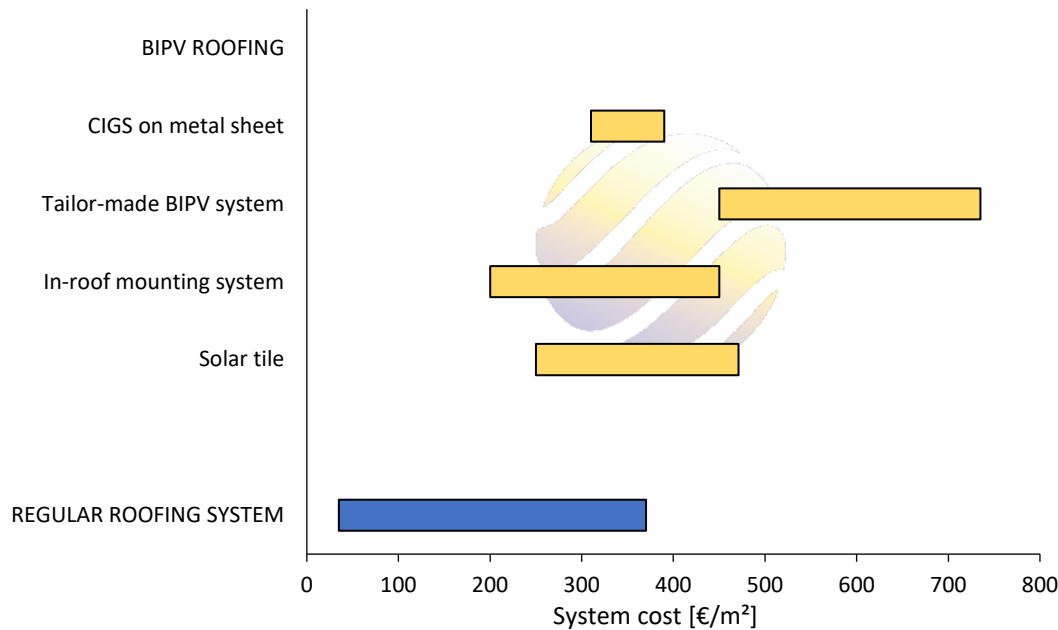
**Metric for the comparison:** NPV in € (normalised into €/m<sup>2</sup>)

**Comparison point:** conventional construction system’s installation project

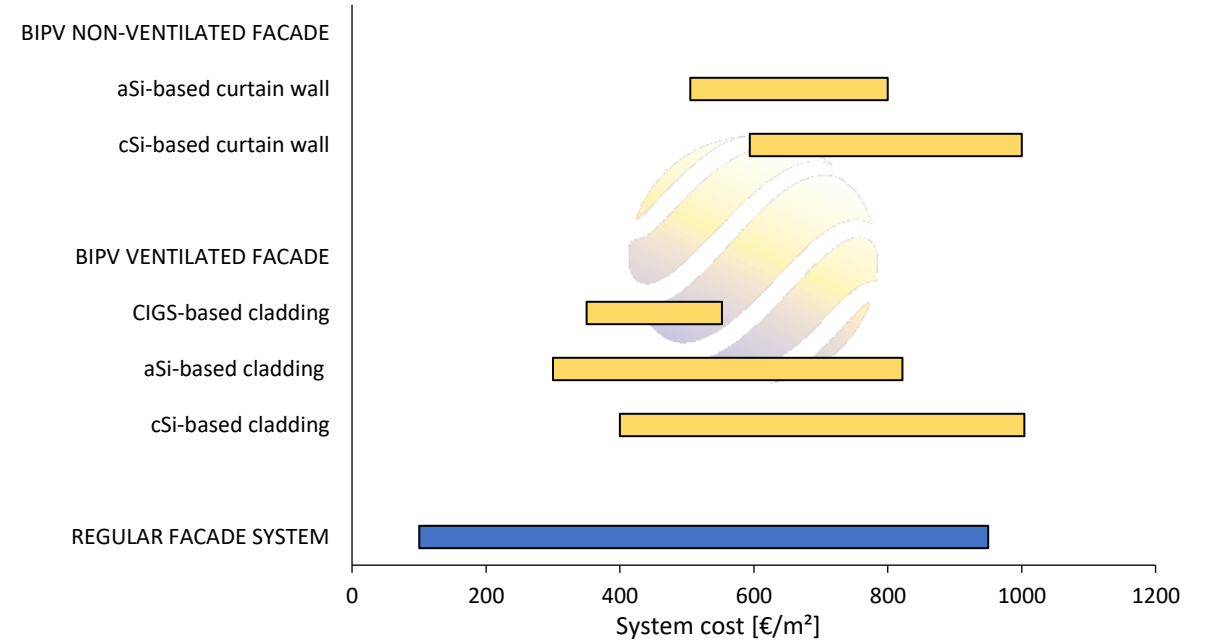
# 1 | What is BIPV competitiveness

## BIPV solutions remain overall more expensive than conventional roof and façade systems, although they can compete with high-end ones

System cost comparison of conventional and BIPV roofing solutions



System cost comparison of conventional and BIPV roofing solutions



- Simple solutions such as in-roof mounting systems can be more competitive than conventional solutions.
- Active BIPV facade solutions remain undoubtedly more expensive than standard façade cladding solutions.

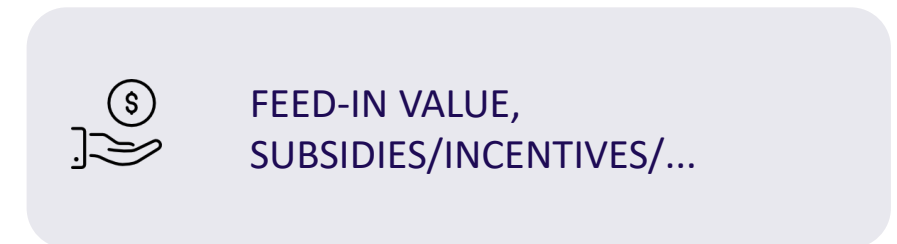
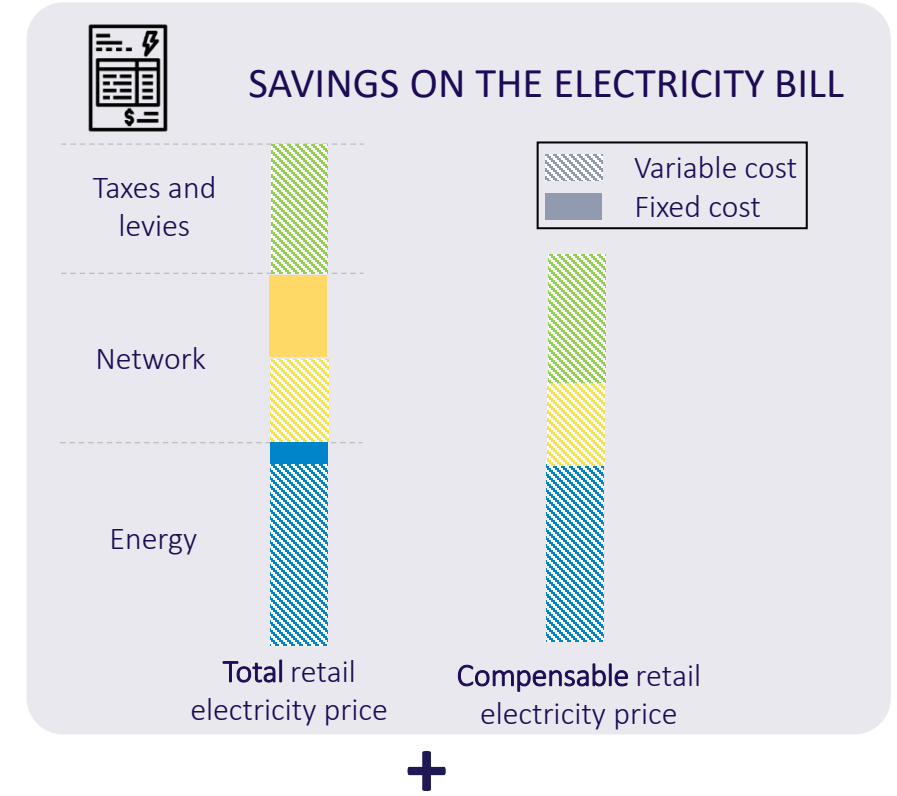
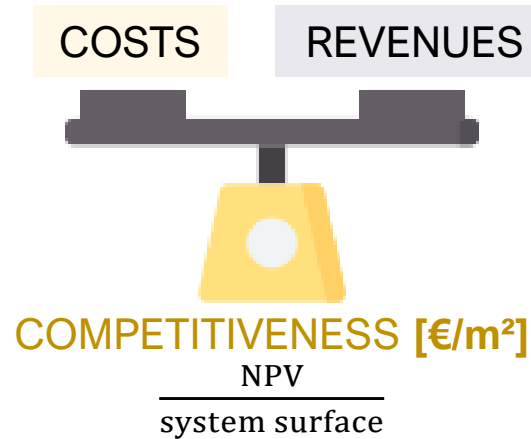
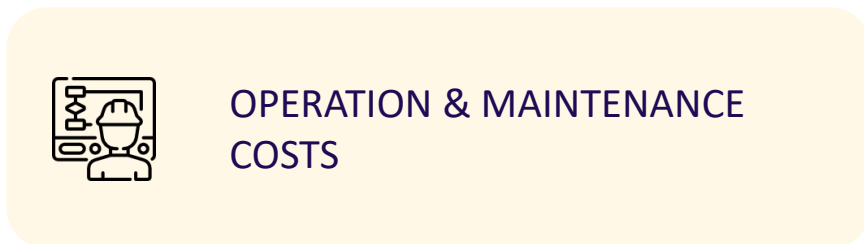
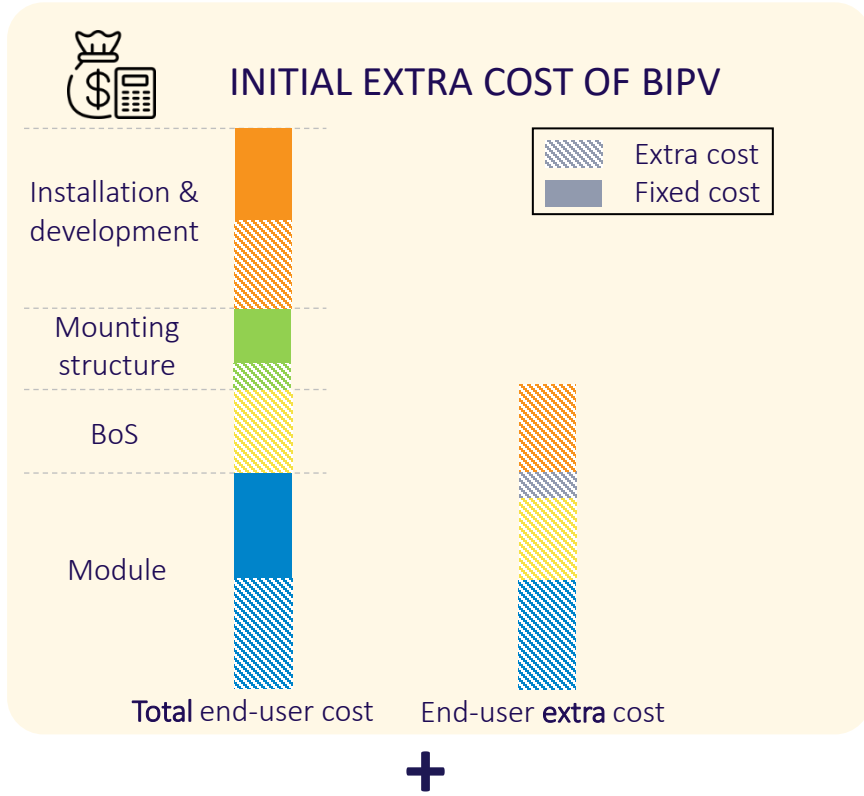
**BUT...**

- BIPV offers an additional functionality which expectedly leads to higher costs.
- Active solutions are often more competitive, from a system-level cost perspective, than the subsequent application of a PV system on a regular roofing solution.

Sources: (1) BIPVBOOST D1.1 "Cost competitiveness status of BIPV solutions in Europe" by Becquerel Institute; (2) "BIPV Status Report 2020" by Becquerel Institute and SUPSI

# 1 | What is BIPV competitiveness

In the “Total Cost of Ownership” approach, the attractiveness of BIPV compared to conventional building envelope solution is also taken into account



# Table of Contents

---

- 1 | What is BIPV competitiveness
- 2 | **BIPV competitiveness status in Europe**
- 3 | Innovations & perspectives for improvement
- 4 | BIPV competitiveness outlook & main influencing factors
- 5 | Key takeaways

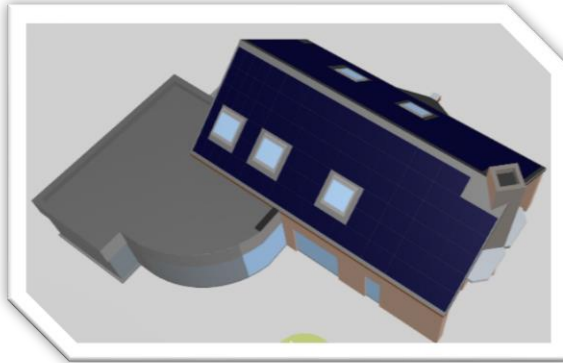


## 2 | BIPV competitiveness status in Europe

The competitiveness of four typical reference cases is presented in the next slides, covering a variety of buildings, technical solutions and configurations

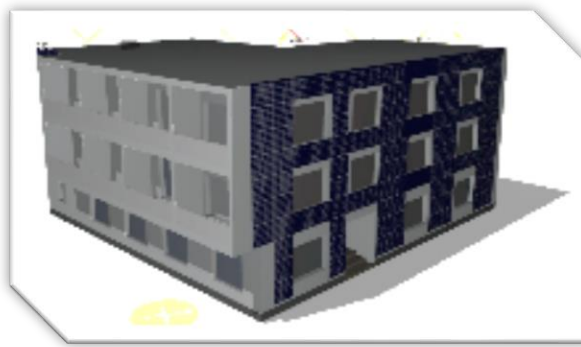
### Residential reference cases

#### SFH : Single family house



- BIPV tiles (c-Si)
- 50 m<sup>2</sup>
- 30° tilted, south-oriented
- 6 kWp
- 35% self-consumption rate
- Average compensable retail electricity price\* : 31,4 c€/kWh

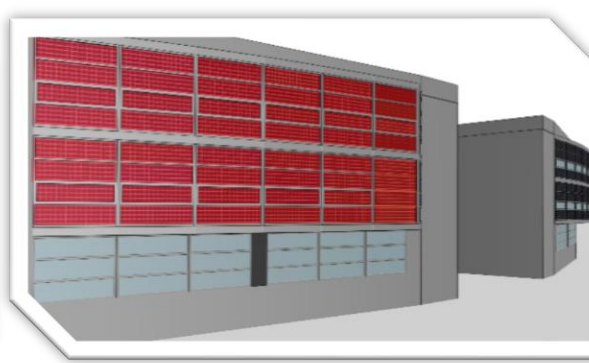
#### MFH : Multi-family house



- Ventilated opaque façade (c-Si)
- 300 m<sup>2</sup>
- Vertical, south-oriented
- 46 kWp
- 60% self-consumption rate
- Average compensable retail electricity price : 31,4 c€/kWh

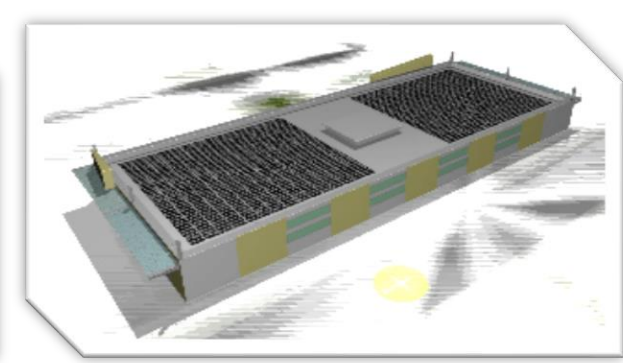
### Non-residential reference cases

#### OB : Office Building



- Curtain wall semi-transparent (c-Si)
- 270 m<sup>2</sup>
- Vertical, south-oriented
- 25 kWp
- 90% self-consumption rate
- Average compensable retail electricity price : 30,5 c€/kWh

#### IB : Industrial Building



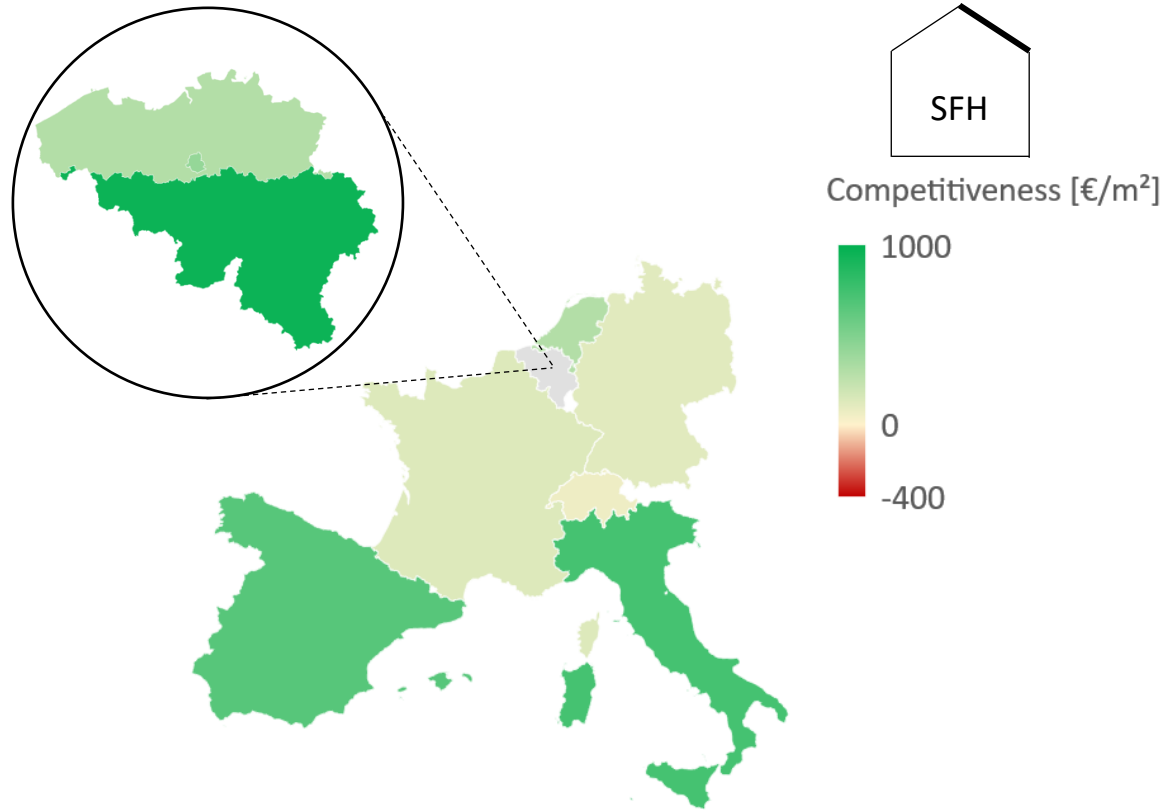
- Lightweight metal roofing (CIGS)
- 1400 m<sup>2</sup>
- Flat
- 180 kWp
- 100% self-consumption rate
- Average compensable retail electricity price : 20 c€/kWh

\* Electricity prices are based on the EICOM for Switzerland (year 2022) and on Eurostat statistics (S2 2022) for the remaining countries

## 2 | BIPV competitiveness status in Europe

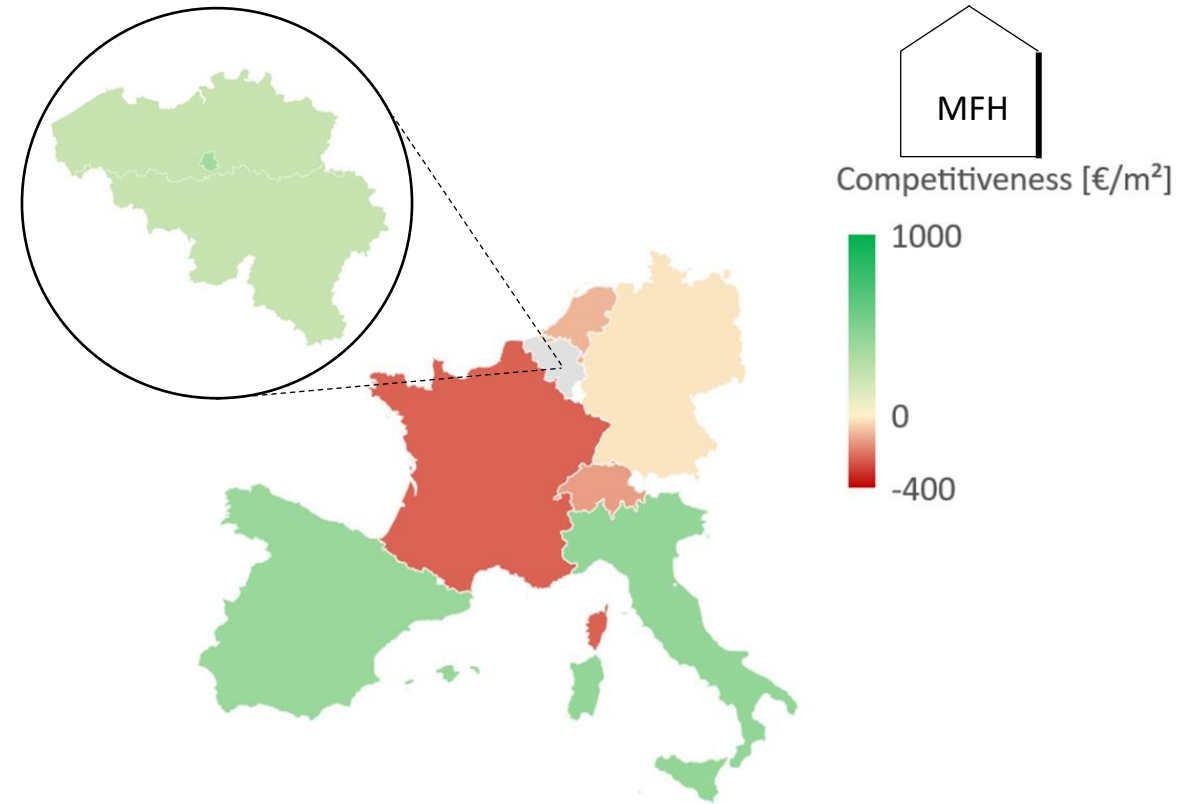
On roofs, residential BIPV systems show very competitive results, while when installed on facades the results are more mixed, as the configuration is non optimal

Competitiveness of the SFH reference case in key European countries



- ✓ High retail electricity prices
- ✓ High system power density (opaque solution)
- ✓ Tilted roof (good irradiation conditions)

Competitiveness of the MFH reference case in key European countries

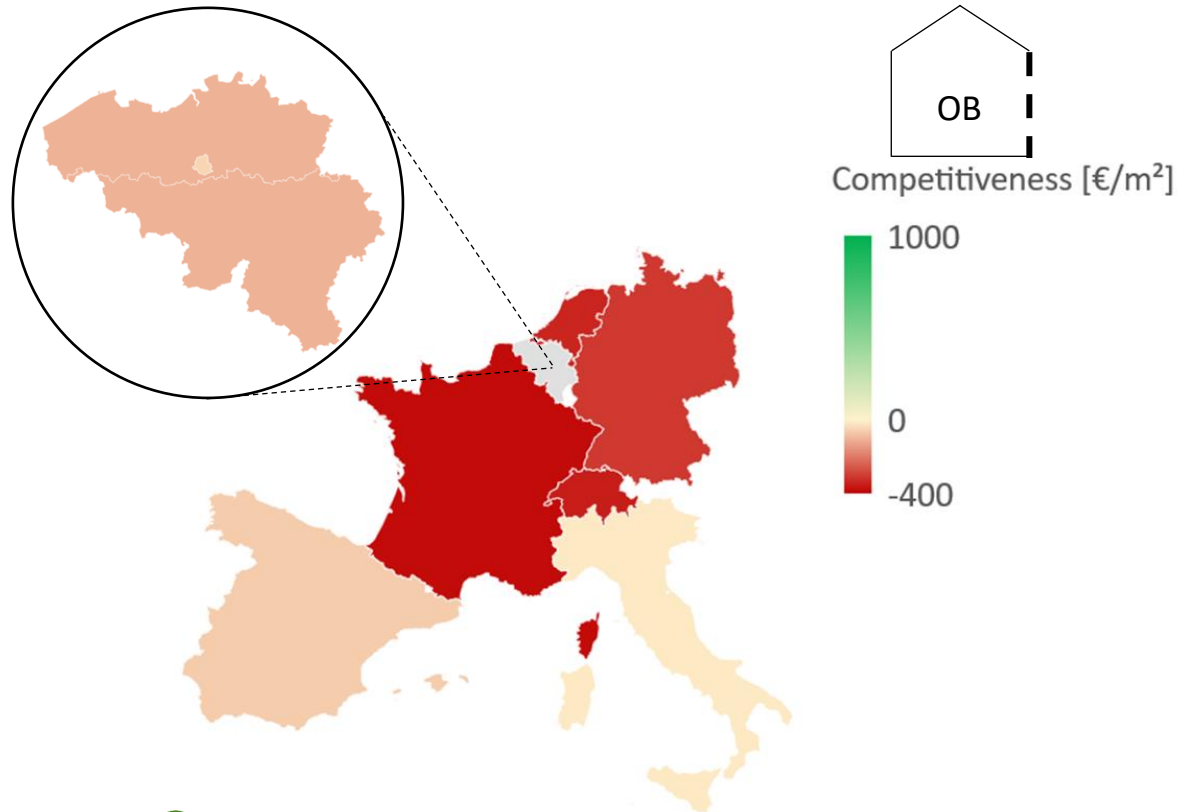


- ✓ High retail electricity prices
- ✓ Relatively high system power density (opaque solution)
- ⊖ Vertical tilt (poor irradiation conditions)

## 2 | BIPV competitiveness status in Europe

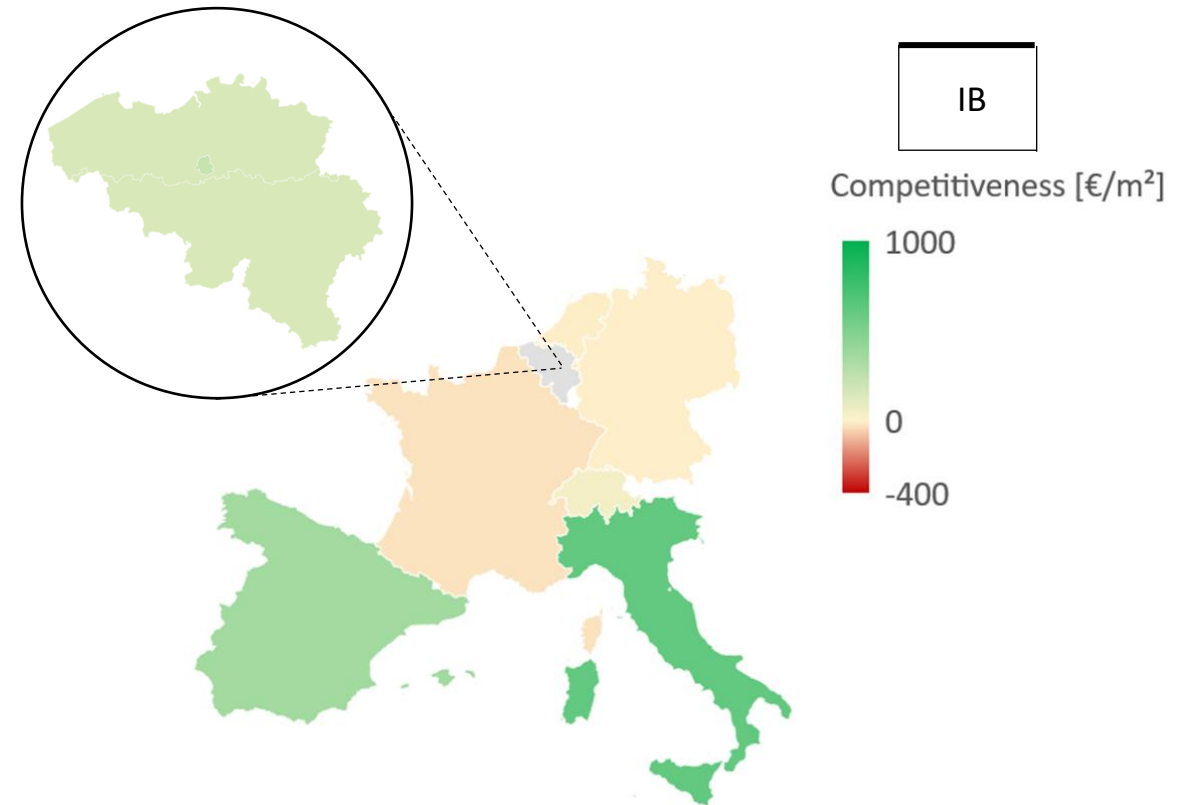
# The office building BIPV reference case suffers from a combination of unfavorable factors, including high cost and a low power density

Competitiveness of the OB reference case in key European countries



- ✓ Relatively high self-consumption
- ✓ Medium retail electricity prices
- ⊖ Vertical tilt (poor irradiation conditions)
- ⊖ Low system power density (semi-transparent solution)

Competitiveness of the IB reference case in key European countries



- ✓ High system power density (opaque solution)
- ✓ High self-consumption
- ✓ Horizontal tilt (medium irradiation conditions)
- ⊖ Lower retail electricity prices

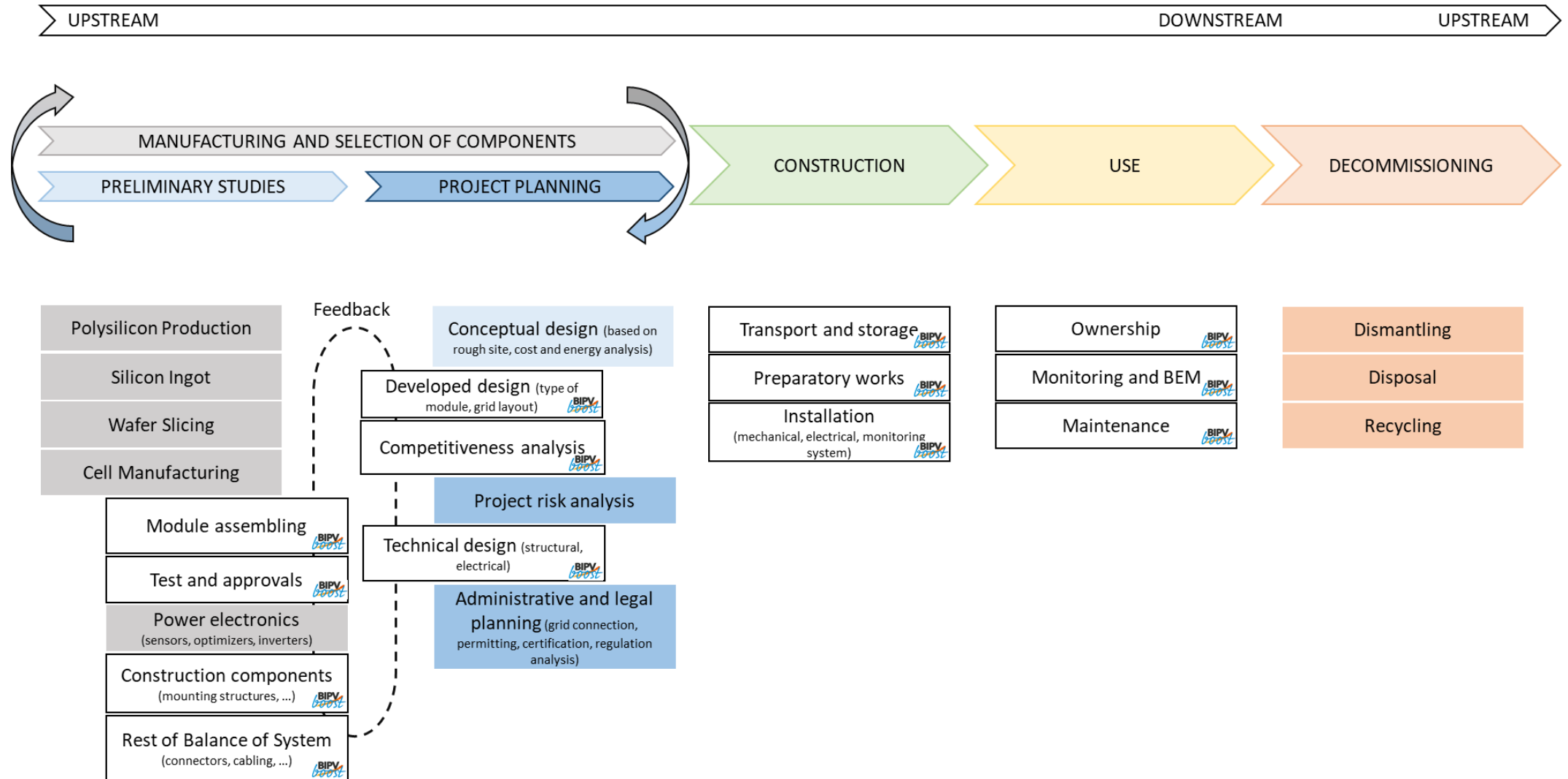
# Table of Contents

---

- 1 | What is BIPV competitiveness
- 2 | BIPV competitiveness status in Europe
- 3 | **Innovations & perspectives for improvement**
- 4 | BIPV competitiveness outlook & main influencing factors
- 5 | Key takeaways

### 3 | Innovations & perspectives for improvement

The innovations developed in the BIPVBOOST project allow cost savings along the entire BIPV value chain, from planning and design to use phases



### 3 | Innovations & perspectives for improvement

# BIPVBOOST innovations will generate direct cost savings and keep on having benefits after the end of the project, enabling two-digit cost reductions by 2030



Flexible and Automatic BIPV module **manufacturing** and quality control line

**Targeted impact:**  
Reduced **module manufacturing cost** [€/m<sup>2</sup>]  
(through reduced manpower needs, reduced failure rates, ...)

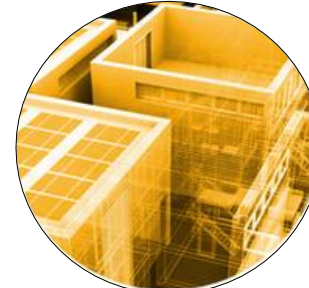
**-10% total end-user cost  
by 2030**



Portfolio of low-cost and aesthetically advanced glass-glass BIPV **products**

**Targeted impact:**  
Reduced **system end-user cost** [€/m<sup>2</sup>]  
(through more cost-efficient coloring and patterning techniques, ...)

**-40% total end-user cost  
by 2030**



BIM-based **software** tool  
*supporting the design, manufacturing,  
installation, operation and maintenance*

**Targeted impact:**  
Reduced **system end-user cost** [€/m<sup>2</sup>]  
(through reduced times needed for the design and collaboration/communication between architects, designers, engineers, ...)

**-2% total end-user cost  
by 2030**



Enhanced, cost effective BIPV roof and facades **systems** for CIGS on metal and c-Si glass-glass

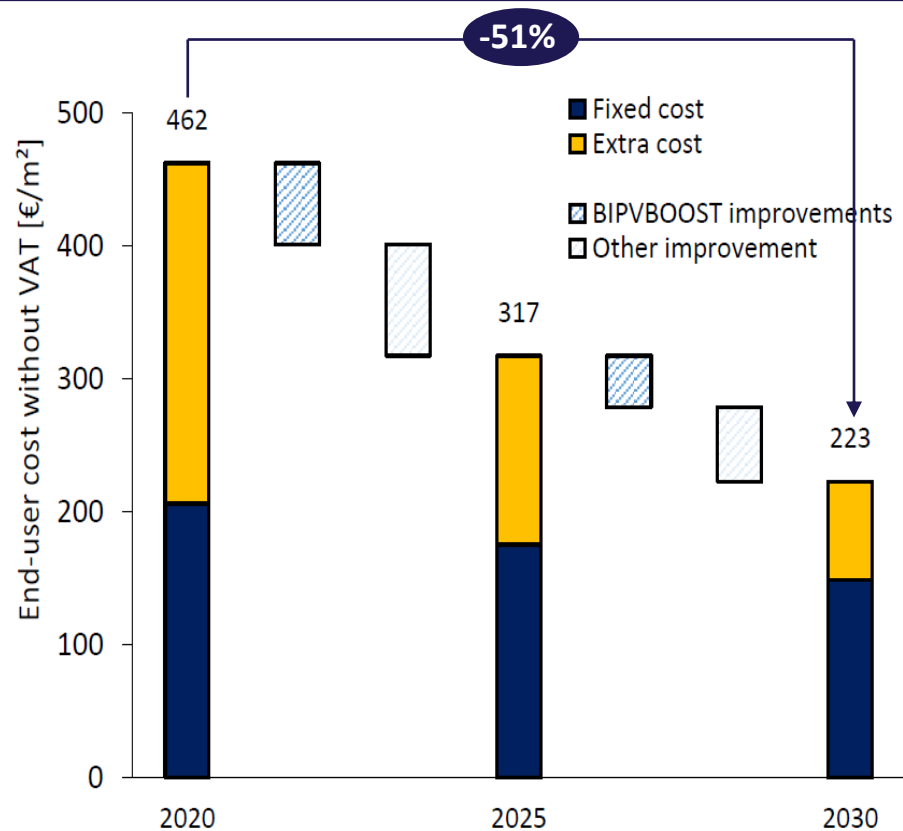
**Targeted impact:**  
Reduced **system end-user cost** [€/m<sup>2</sup>]  
(through easier installation thanks to lightweight products, adapted mounting structures, ...)

**-55% total end-user cost  
by 2030**

### 3 | Innovations & perspectives for improvement

## BIPV solutions will also benefit from external improvements, including innovations and optimisation arising from the PV, BIPV and construction sectors

Example of different cost reduction sources for a rainscreen façade as evaluated in 2020



Potential external sources and drivers of improvements are plentiful

- From the PV sector:  
*Improvement of silicon crystallisation process, wafering technologies, equipment effectiveness of c-Si cell production tools, metallisation process, inverter costs, ...*
  - From the construction sector:  
*Improved knowledge on BIPV and information flows, simplification of administrative and legal procedures, ...*
  - From the BIPV sector:  
*Economies of scale and industrialization, digitalization, installation procedures, ...*
- ➔ Overall, both **market-pull** and **technology-push** is required in order to effectively achieve all/most expected impacts of the above improvements, **including the support of the right regulatory measures.**

# Table of Contents

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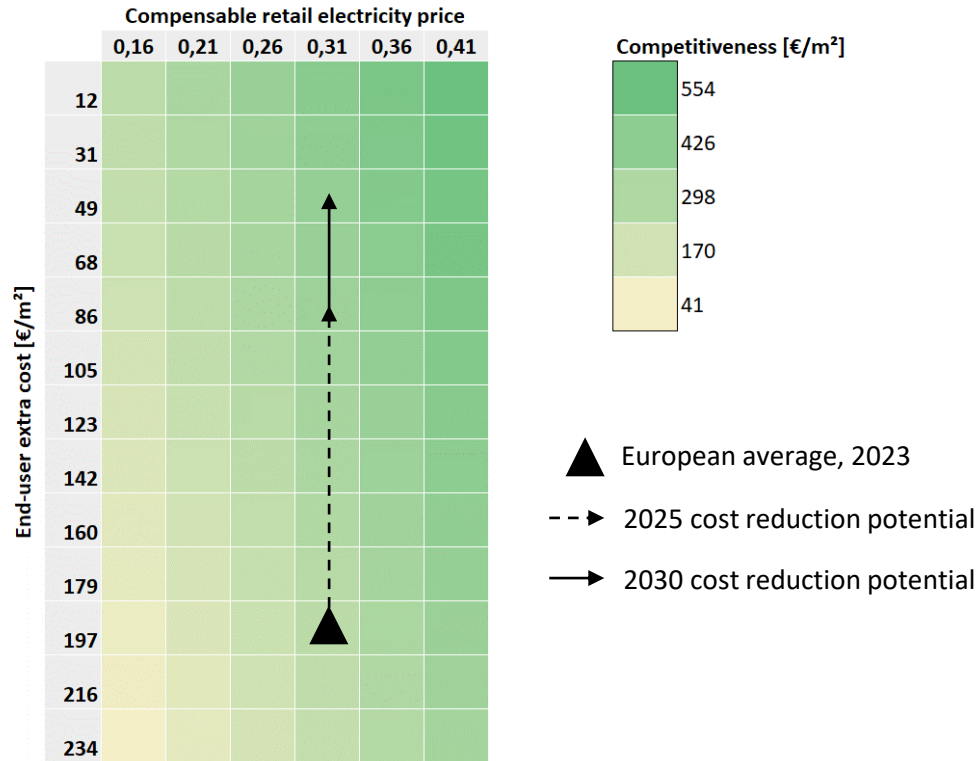
- 1 | What is BIPV competitiveness
- 2 | BIPV competitiveness status in Europe
- 3 | Innovations & perspectives for improvement
- 4 | **BIPV competitiveness outlook & main influencing factors**
- 5 | Key takeaways



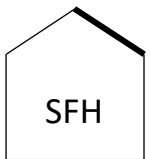
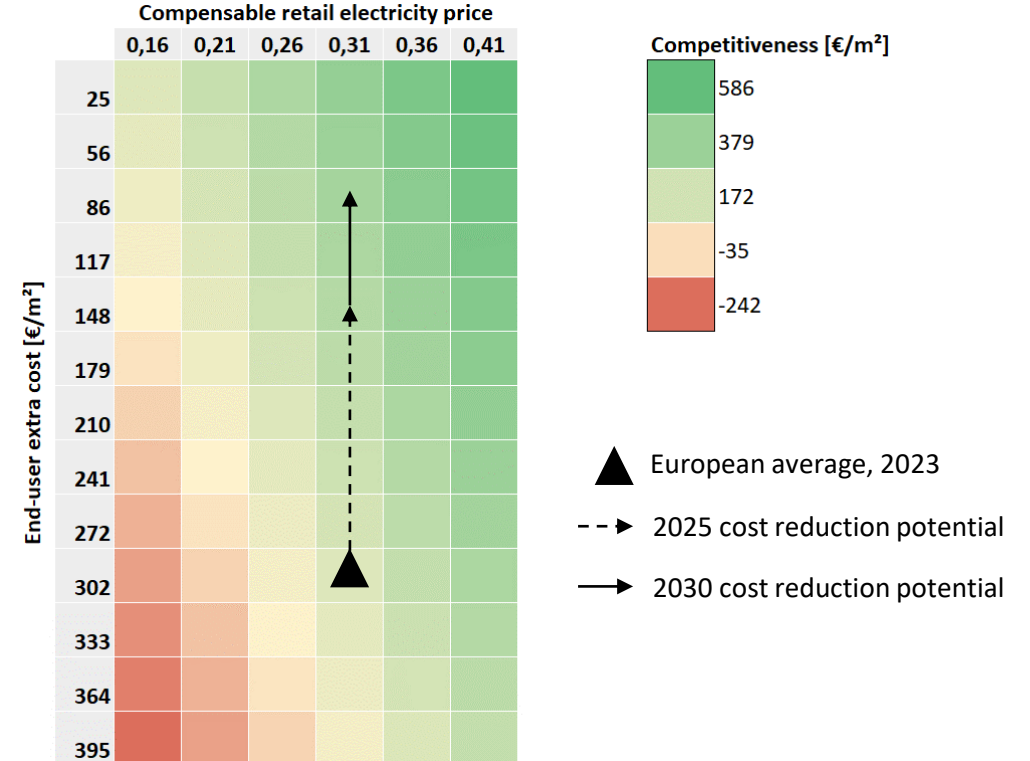
## 4 | BIPV competitiveness outlook & main influencing factors

The competitiveness of residential BIPV applications will be reinforced and should be reached in the vast majority of cases in the coming years

Competitiveness outlook the SFH reference case

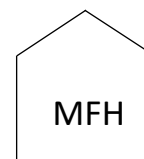


Competitiveness outlook of the MFH reference case



Extra cost for the end-user could be slashed more than two-fold by 2025

Competitiveness would increase almost proportionally

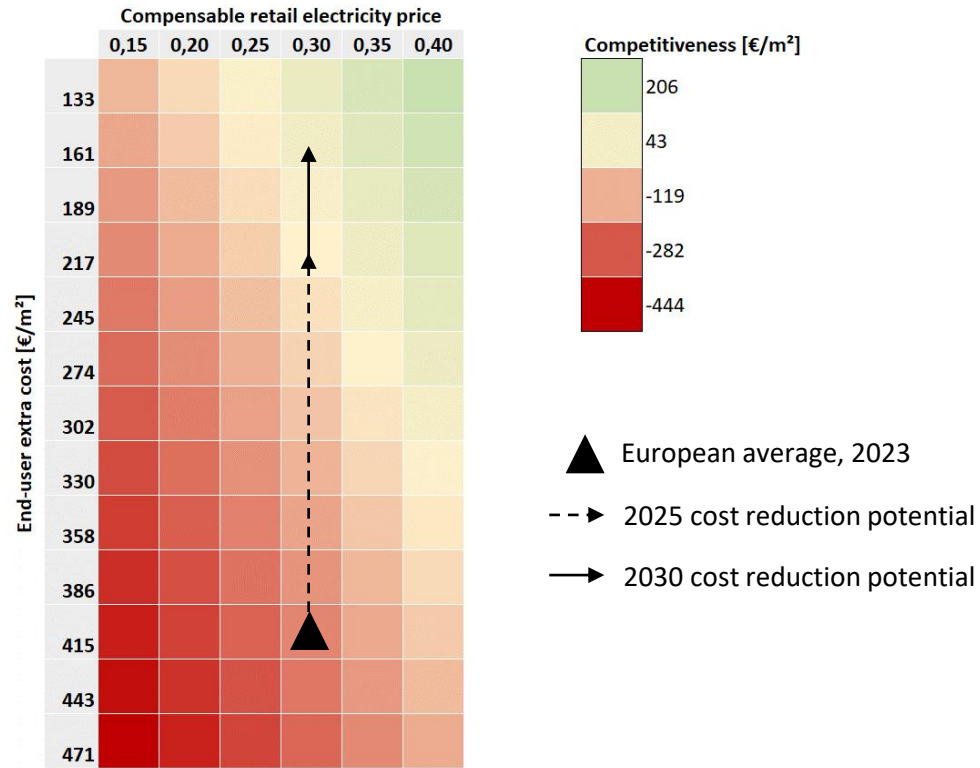


Competitiveness would be in reach, even if retail electricity prices were to decrease significantly

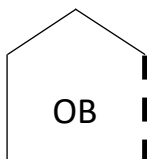
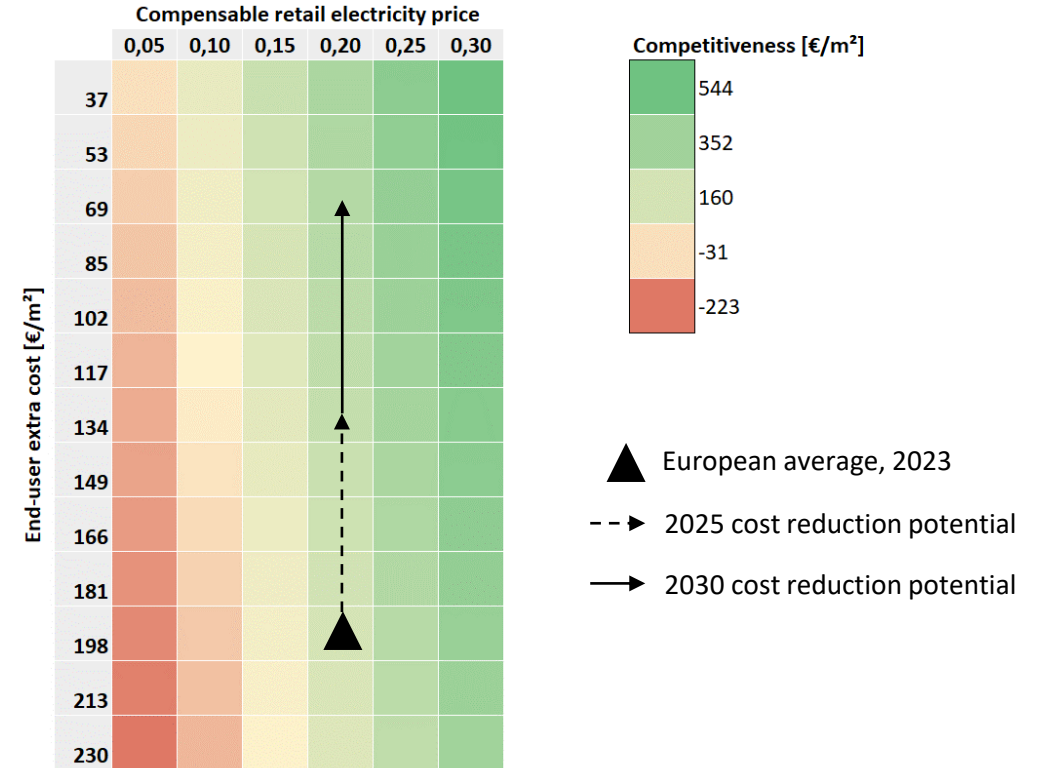
## 4 | BIPV competitiveness outlook & main influencing factors

The competitiveness of the OB reference case will remain subpar and only achievable under specific conditions, such as favourable irradiation or high electricity prices

Competitiveness outlook the OB reference case



Competitiveness outlook of the IB reference case



Extra cost for the end-user would decrease, but in lower proportions compared to the residential cases

Competitiveness could be reached, but under favourable conditions only, as it is the case now

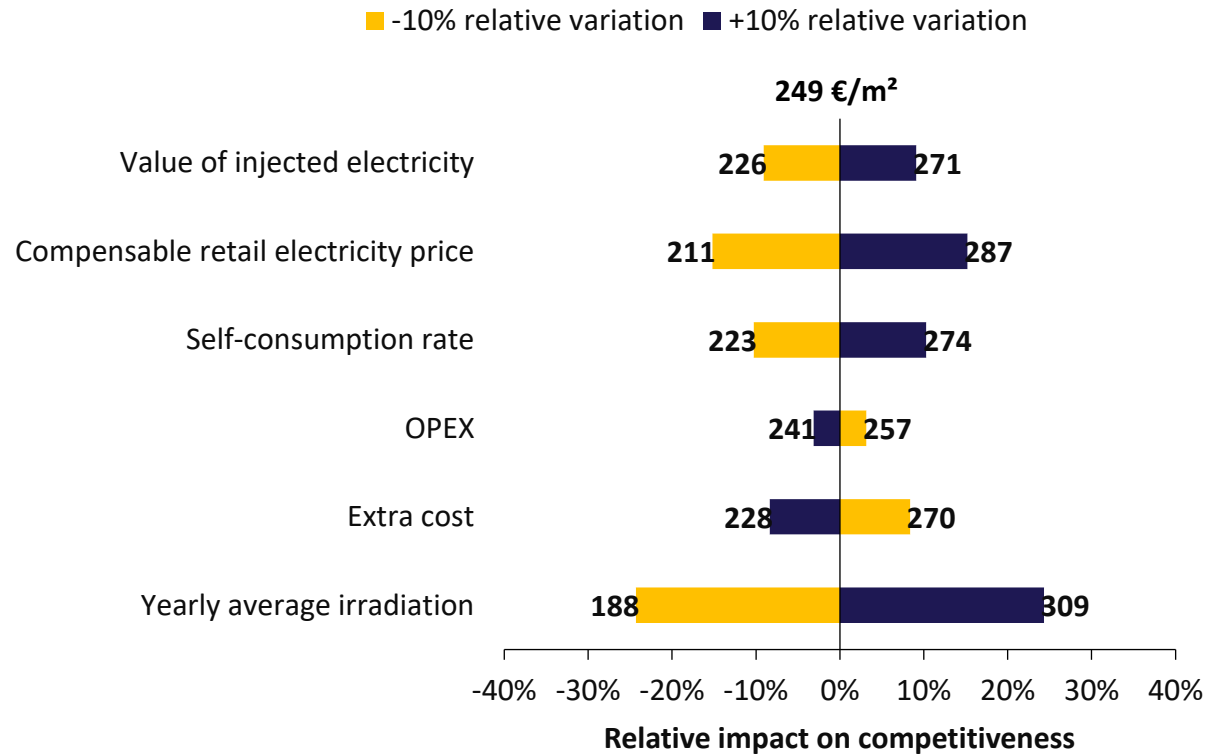


Competitiveness would improve, and reachable even with a substantial decrease of electricity prices

## 4 | BIPV competitiveness outlook & main influencing factors

The enablers of BIPV competitiveness are many fold, with a majority of them out of the hand of the stakeholders, such as the irradiation or the prices of electricity

### Sensitivity of BIPV tiles' competitiveness to different parameters



### Main assumptions

Sensitivity analysis conducted for 6 kWp BIPV tiles system, for an average yearly irradiation of 1500 kWh/m<sup>2</sup>.a, an extra cost of 197 €/m<sup>2</sup>, 35% self-consumption rate, 31c€/kWh compensable retail electricity price and 100 €/MWh for excess electricity injected to the grid.

### Highlights on the influence of key performance parameters

#### > Location-specific enablers:

- Irradiance conditions
- Attractiveness of local support schemes

#### > Project-specific enablers:

- Retail electricity prices in different customer segments.
- Ability to self-consume generated electricity.
- Possibilities to value the electricity fed-back to the grid
- Tilt and orientation of the available surface

#### > BIPV-specific enablers:

- Extra cost of BIPV
- System power density

## 4 | BIPV competitiveness outlook & main influencing factors

Among the enablers of BIPV competitiveness, support schemes can be mentioned among the most influential, with the ability to be game changers

### Examples of BIPV-specific support schemes across Europe

+ BIPV-specific investment premium		
	Amount	Winter bonus (i.e., tilt >75°)
<30 kW	440 CHF/kW	250 CHF/kW
[30-100] kW	350 CHF + 330 CHF/kW	

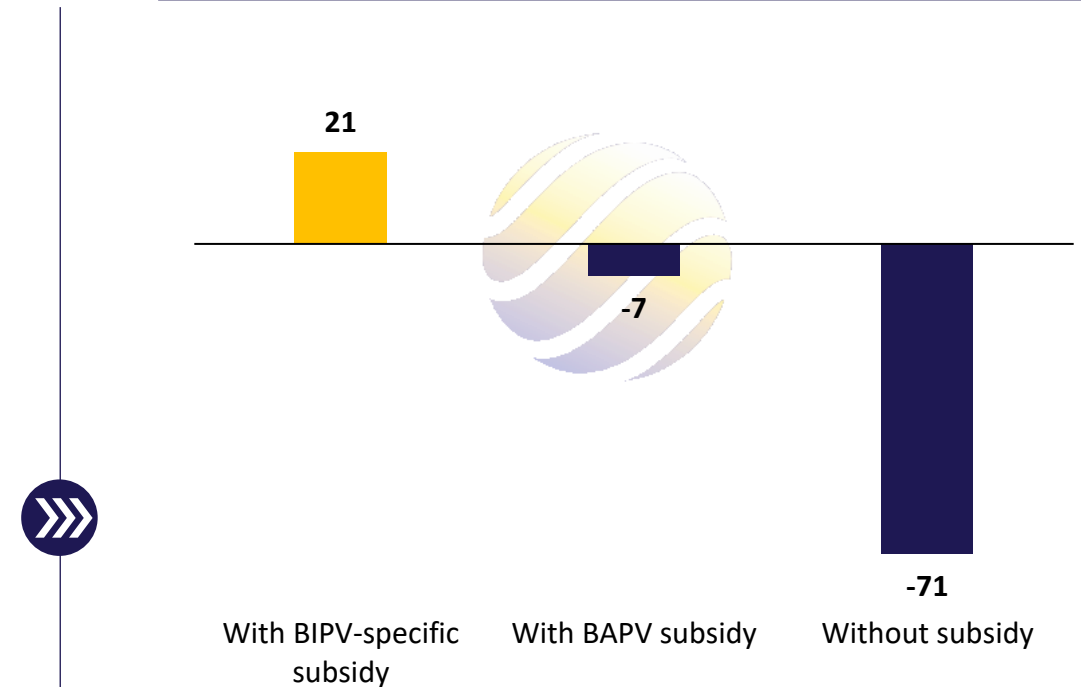
BIPV-specific investment premium	
PV capacity range	Investment support* [€/Wp] From 10/2022 to 10/2023
P <= 100 kWp	0,133
100 kWp < P <= 250 kWp	0,128
250 kWp < P < 500 kWp	0,125

\* Only for a selection of BIPV roof products

BIPV-specific green certificate granting rate	
BIPV categories	Minimum revenues* [€/MWh]
Skylight	123,5
Balcony	123,5
Sun shading	117
Ventilated façade	156
Repetitive structure, full roof system, solar tiles	Same as BAPV

\* Assuming a GC value of 65 €/MWh

### Competitiveness [€/m<sup>2</sup>] of a MFH ventilated façade in Switzerland



➔ BIPV-specific investment premiums can be decisive in reaching the competitiveness threshold

# Table of Contents

---

- 1** | What is BIPV competitiveness
- 2** | BIPV competitiveness status in Europe
- 3** | Innovations & perspectives for improvement
- 4** | BIPV competitiveness outlook & main influencing factors
- 5** | **Key takeaways**

## 5 | Key takeaways

# BIPV solutions are already competitive in many configurations and locations, and the right innovations supported by the right regulatory measures will strengthen their case

- 1 BIPV offers a **wide range of possibilities** in terms of area it can be integrated to, such as shapes, size, colors, transparency, ... and is **already competitive in many of these configurations**, on various segments and locations
- 2 **BIPVBOOST innovations** will significantly contribute **to reduce the cost** of BIPV solutions along the value chain
- 3 But additional improvements driven by market-pull and technology-push from the PV, BIPV and construction sectors are also essential, **as well as regulators !**
- 4 Overall, **perspectives for BIPV are promising** on the short to medium-term for all types of BIPV systems and all European locations.

# How to get more information?

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Download the full technical reports at

[www.bipvboost.eu](http://www.bipvboost.eu)



# Thanks! Questions are welcome

Contact: [p.mace@becquerelinstitute.eu](mailto:p.mace@becquerelinstitute.eu)

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