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BIPV Solutions in Europe: Competitiveness Status & Roadmap Towards 2030

Presented by Philippe Macé, **Becquerel Institute**



Empowering Companies to Embrace the Solar PV Driven Energy Revolution



Becquerel Institute



- Est. 2014 in Brussels, Belgium
- Focused on solar and its related ecosystems (storage, electro mobility, buildings)
- **Applied research and strategic advisory firm**
- **Operational advisory services**
- **Support the PV, storage and EV ecosystems**

Consultancy references:

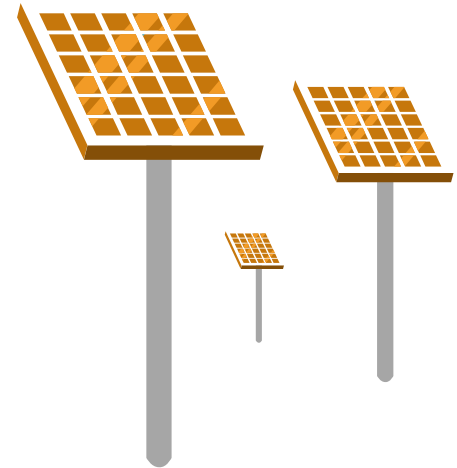


Research projects:



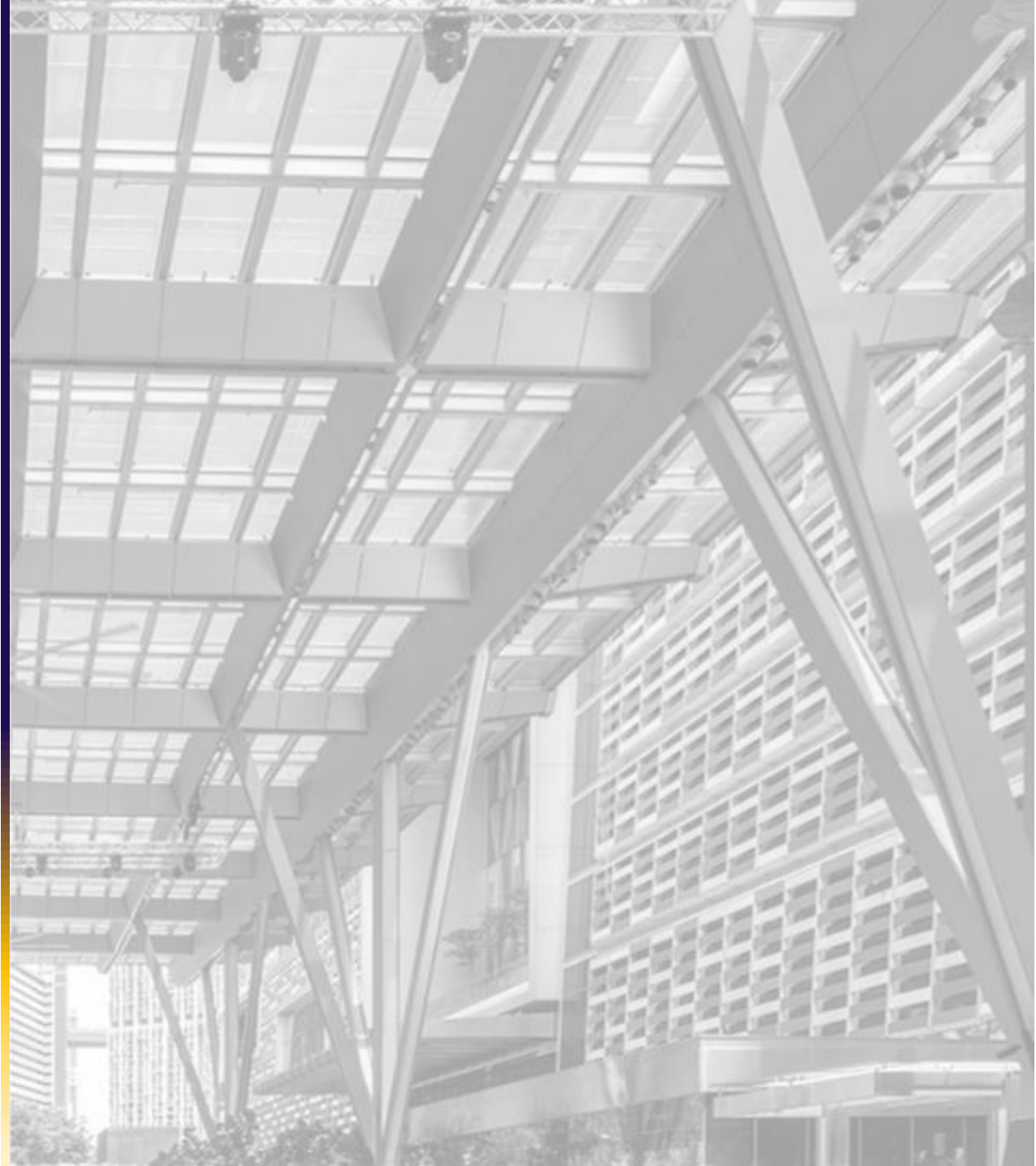
Today's agenda

- 1 BIPVBOOST project at a glance
- 2 What is BIPV ?
- 3 Current status of BIPV competitiveness
- 4 BIPVBOOST innovations
- 5 Perspectives for BIPV competitiveness in Europe





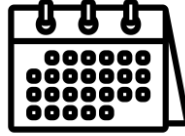
BIPVBOOST Project at a Glance



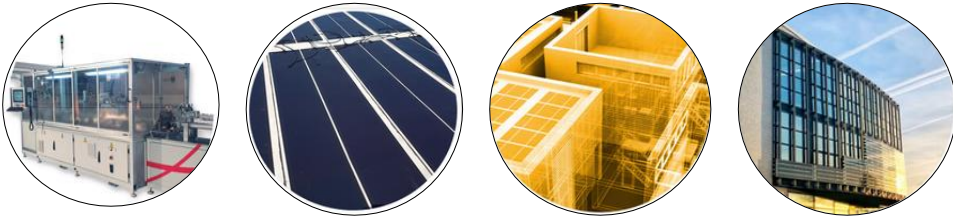
BIPVBOOST Horizon 2020 Project

Bringing down the cost of BIPV solutions and processes

4-years project [2018 – 2022]



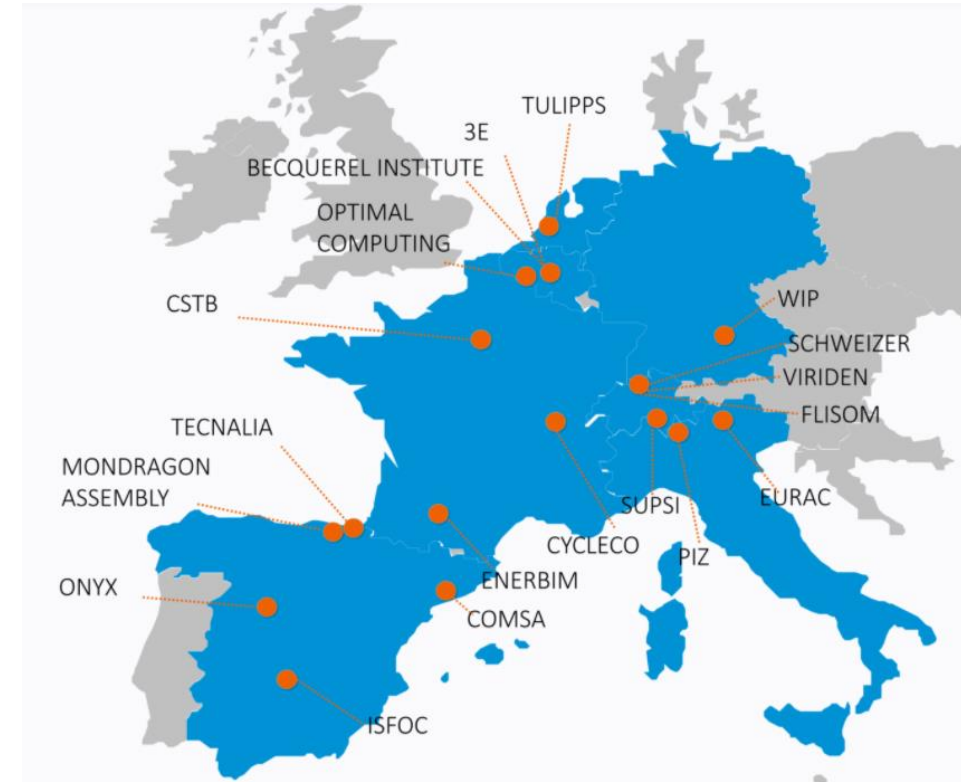
OBJECTIVES



- BIPVBOOST aims at **bringing down costs** of multifunctional building- integrated photovoltaic (BIPV) solutions and processes along the value chain, enabling widespread nZEBs implementation.
- BIPVBOOST will ensure to spread the message of “**BIPV as flexible, reliable and cost-effective technology**” across the different members of the BIPV community: BIPV technology providers, construction product manufacturers, architects designers, engineers, prescribers, scientific community, investors, certification bodies and policy makers.

CONSORTIUM

19 partners (researchers and industrials) from 7 European countries



BIPVBOOST has been awarded by the European Commission in 2018 as a new Innovation Action at European level, funded under the Horizon 2020 programme.





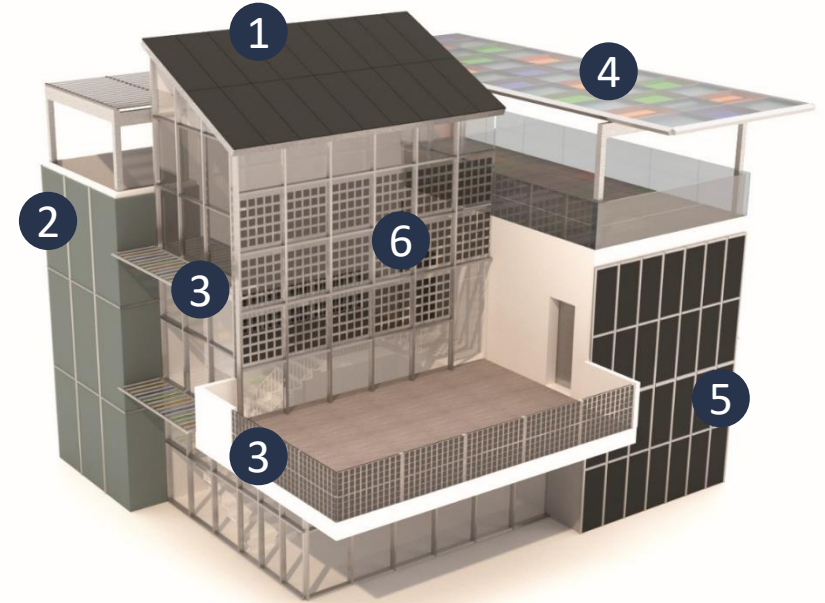
What is BIPV?



BIPV offers a great variety of possibilities

In terms of areas in can be integrated to as well as in terms of aesthetics (colour, pattern, transparency, ...)

- BIPV: Building Integrated Photovoltaic (in opposition to other integrated PV applications like VIPV)
- BIPV fulfils both a **construction material function** (thus bearing the same requirements as a conventional construction material in terms of watertightness, fire resistance, load resistance, ...) and an **electricity generation function**.
- BIPV can be integrated to **facades and roofs**, can be found with different levels of **transparency**, with different **colours and patterns**.



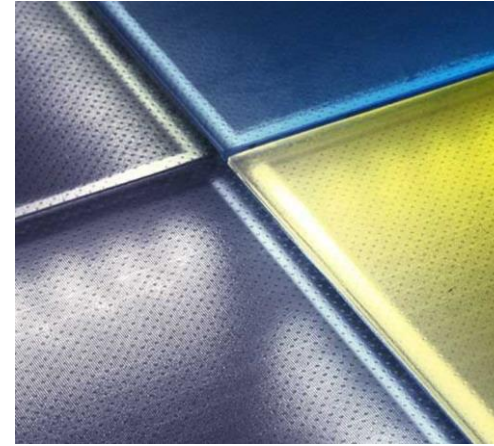
- 1 Cold roof
- 2 Ventilated façade
- 3 External integrated devices (louvers, balustrades,...)
- 4 Skylight
- 5 Prefabricated system
- 6 Curtain wall

Source: "BIPV Status Report 2020" by Becquerel Institute and SUPSI

From standardized/simplified BIPV to customized BIPV



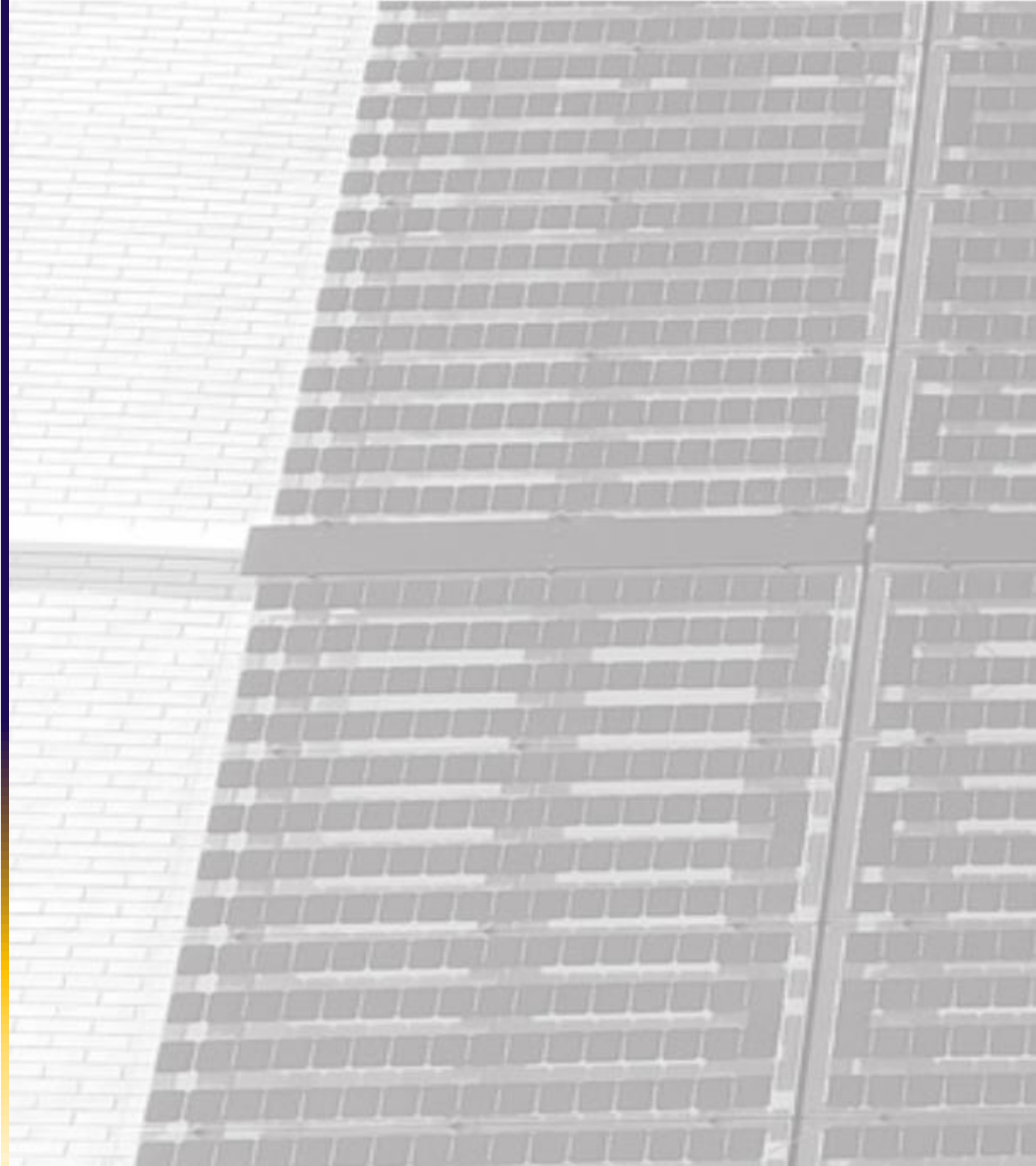
- In-roof mounting BIPV system
- Uses conventional PV modules



- Customizable in colours, transparency, shapes...
- Uses custom made PV cells/modules



Current Competitiveness of BIPV



Multi-level competitiveness assessment for a multifunctional solution

Because BIPV is multifunctional, its competitiveness can be evaluated at different levels.

- As a construction component



Metric for the comparison: €/m²

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

- As an electricity generation unit



Metric for the comparison: €/kWh

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

- As a construction system



Metric for the comparison: €/m²

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

- As a project (“holistic/TCO approach”)



Metric for the comparison: NPV in € (normalised into €/m²)

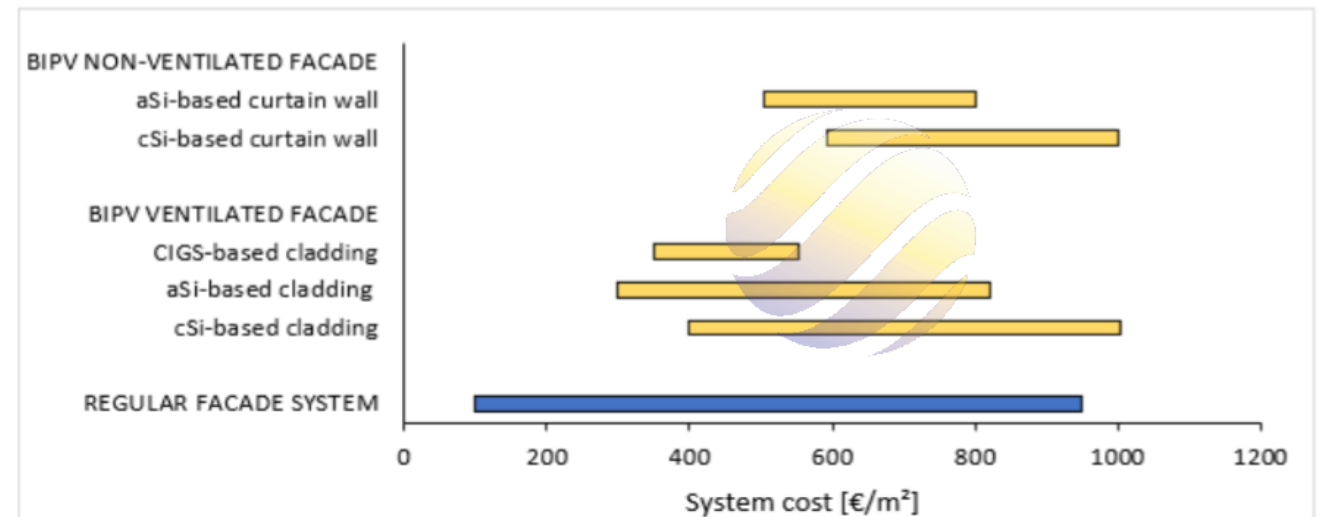
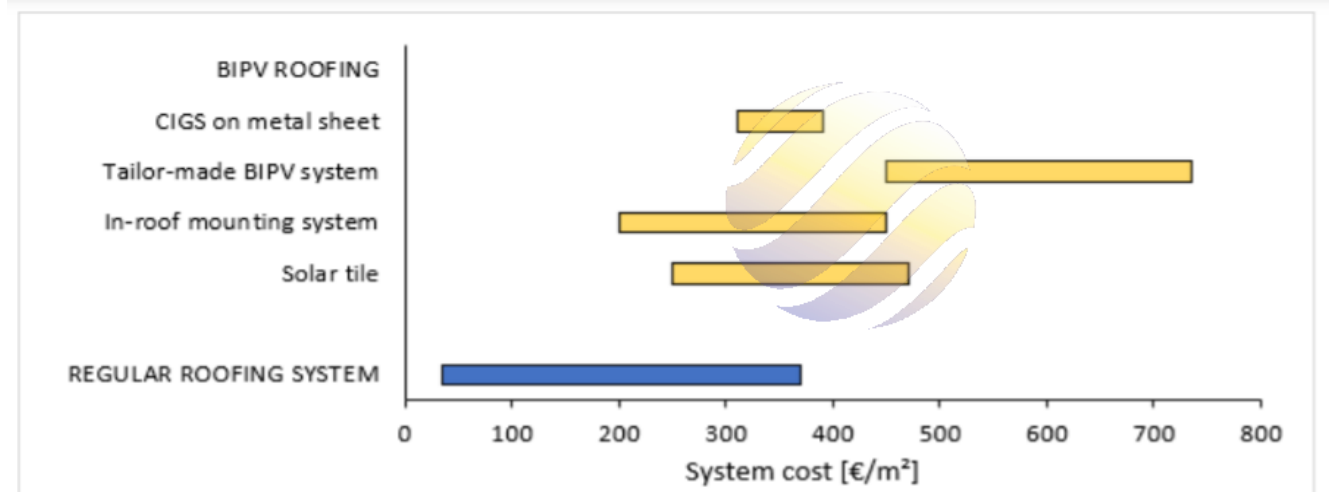
Comparison point: conventional construction system’s installation project

BIPV solutions can compete with high-end conventional roof and façade systems

But remain overall more expensive

- 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.

Range of systems costs for conventional and BIPV systems



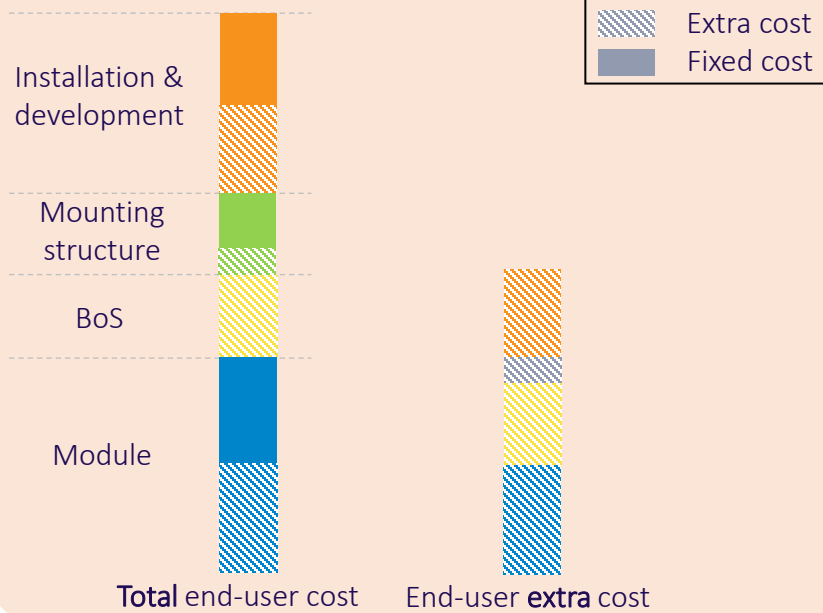
Sources:

- 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

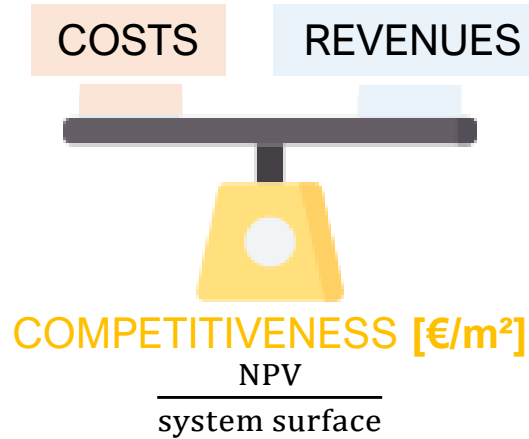
Total cost and revenue of ownership approach

Investing in a BIPV system vs. investing in a competing conventional building envelope solution

INITIAL EXTRA COST



OPERATION & MAINTENANCE COSTS



SAVINGS ON THE ELECTRICITY BILL



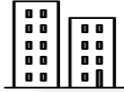
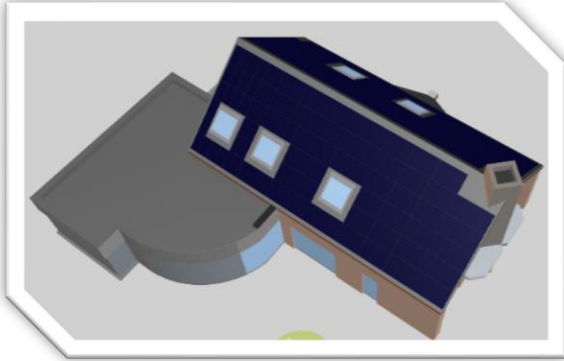
SUBSIDIES/INCENTIVES/...

Four reference cases have been analysed

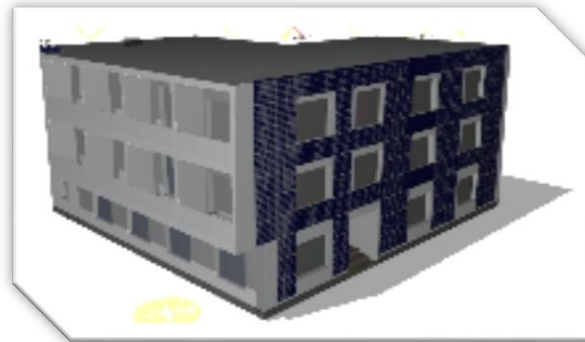
RESIDENTIAL BUILDINGS



SFH : Single family house



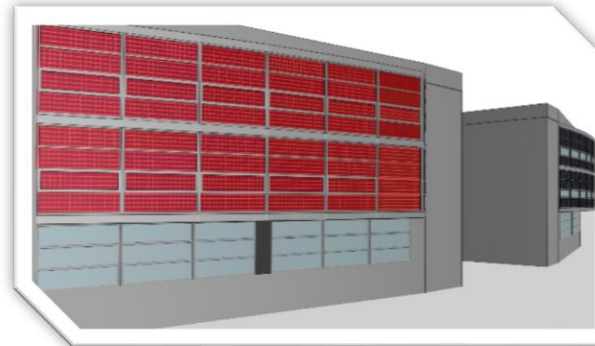
MFH : Multi-family house



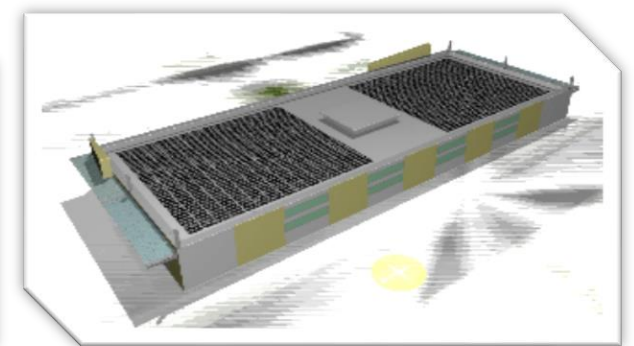
NON-RESIDENTIAL BUILDINGS



OB : Office Building

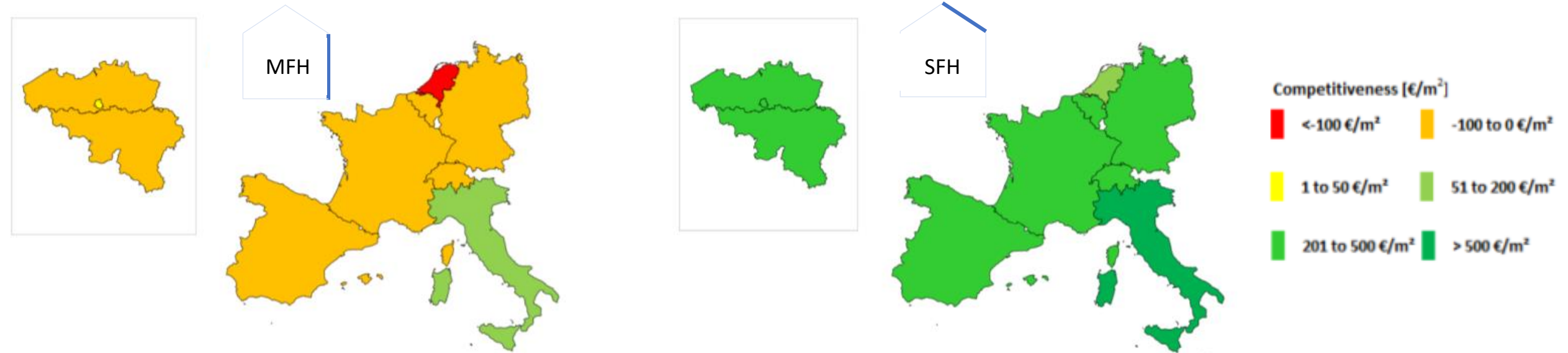


IB : Industrial Building



Residential BIPV systems for SFH offer attractive competitiveness results

Results for MFH are encouraging

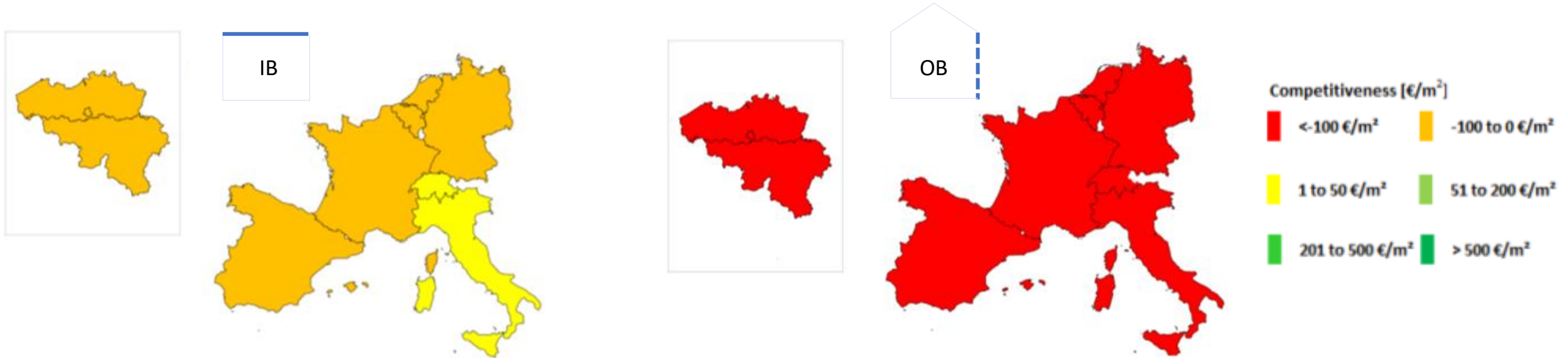


- ✓ High retail electricity prices
- ✓ Relatively high system power density (opaque solution)
- ✗ Vertical tilt (poor irradiation conditions)

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

BIPV roof systems for industrial buildings offer mitigated competitiveness results

BIPV for office buildings suffers from a combination of unfavorable factors



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

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

Enablers for BIPV competitiveness can be of various nature

🌐 Country- and project-specific enablers:

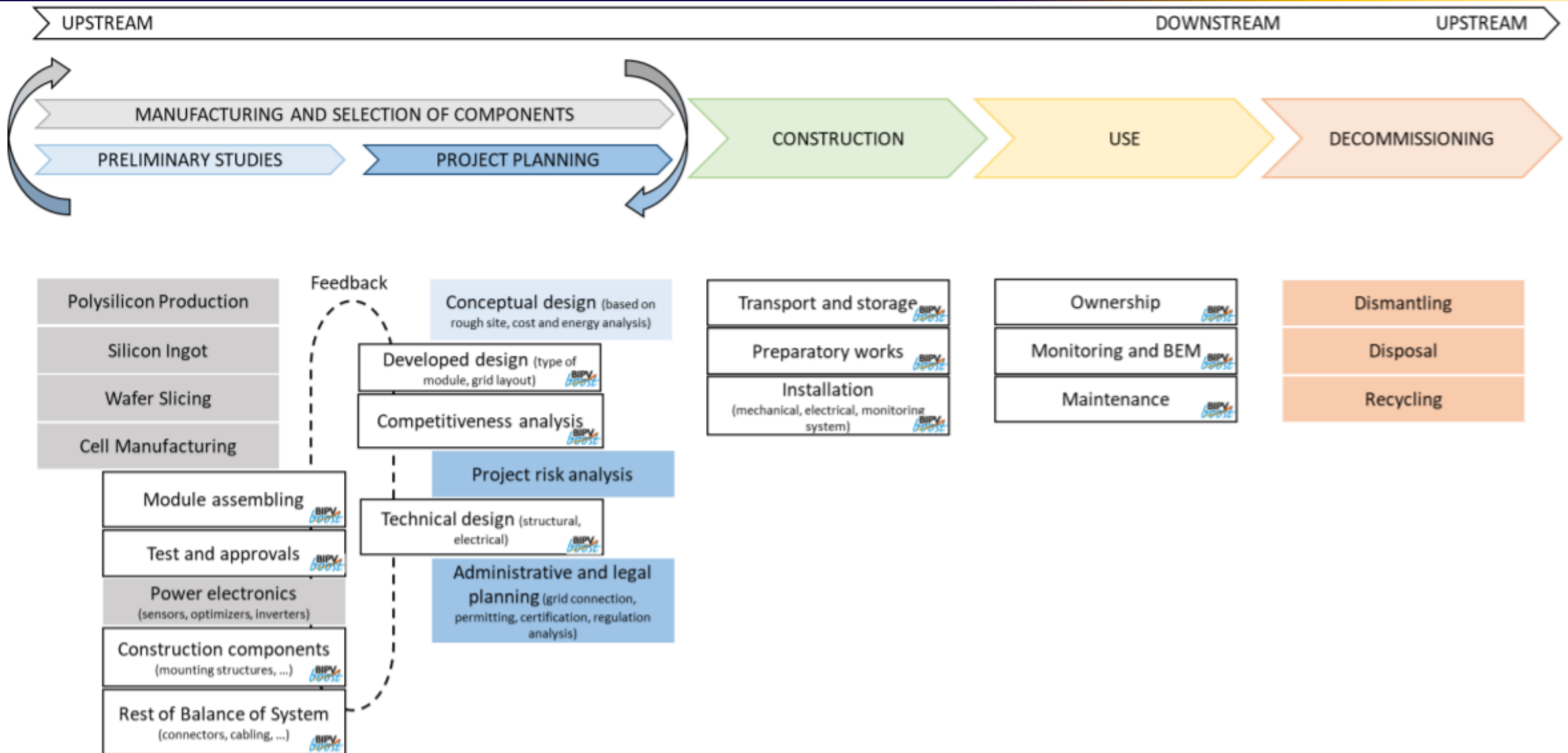
- irradiance conditions,
- attractiveness of available support schemes,
- retail electricity prices in different customer segments.
- ability to self-consume generated electricity.
- possibilities to value the electricity fed-back to the grid

🌐 BIPV system-specific enablers:

- extra cost,
- tilt and orientation of the BIPV system,
- system power density.



Bringing down costs of BIPV solutions and processes **all along the value chain**



Bringing down costs of BIPV solutions and processes **all along the value chain**



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

Targeted impact:

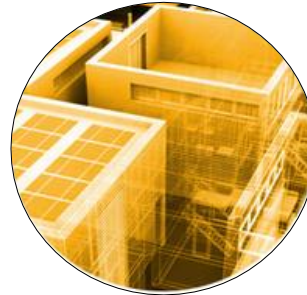
Reduced **module manufacturing cost** [€/m²]
(through reduced manpower needs, reduced failure rates, ...)



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

Targeted impact:

Reduced **end-user cost** [€/m²]
(through more cost-efficient coloring and patterning techniques, ...)



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

Targeted impact:

Reduced **end-user cost** [€/m²]
(through reduced times needed for the design and collaboration/communication between architects, designers, engineers, ...)



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

Targeted impact:

Reduced **end-user cost** [€/m²]
(through easier installation thanks to lightweight products, adapted mounting structures, ...)

BIPV will also benefit from external improvements

These include innovations arising from the PV, BIPV and construction sector

- Potential external sources and drivers of improvements are plentiful.

- From the PV sector

- improvement of silicon crystallisation process, wafering technologies, equipment effectiveness of cSi cell production tools, metallisation process, inverter costs, ...*

- From the construction sector

- improved knowledge on BIPV and information flows, simplification of administrative and legal procedures, ...*

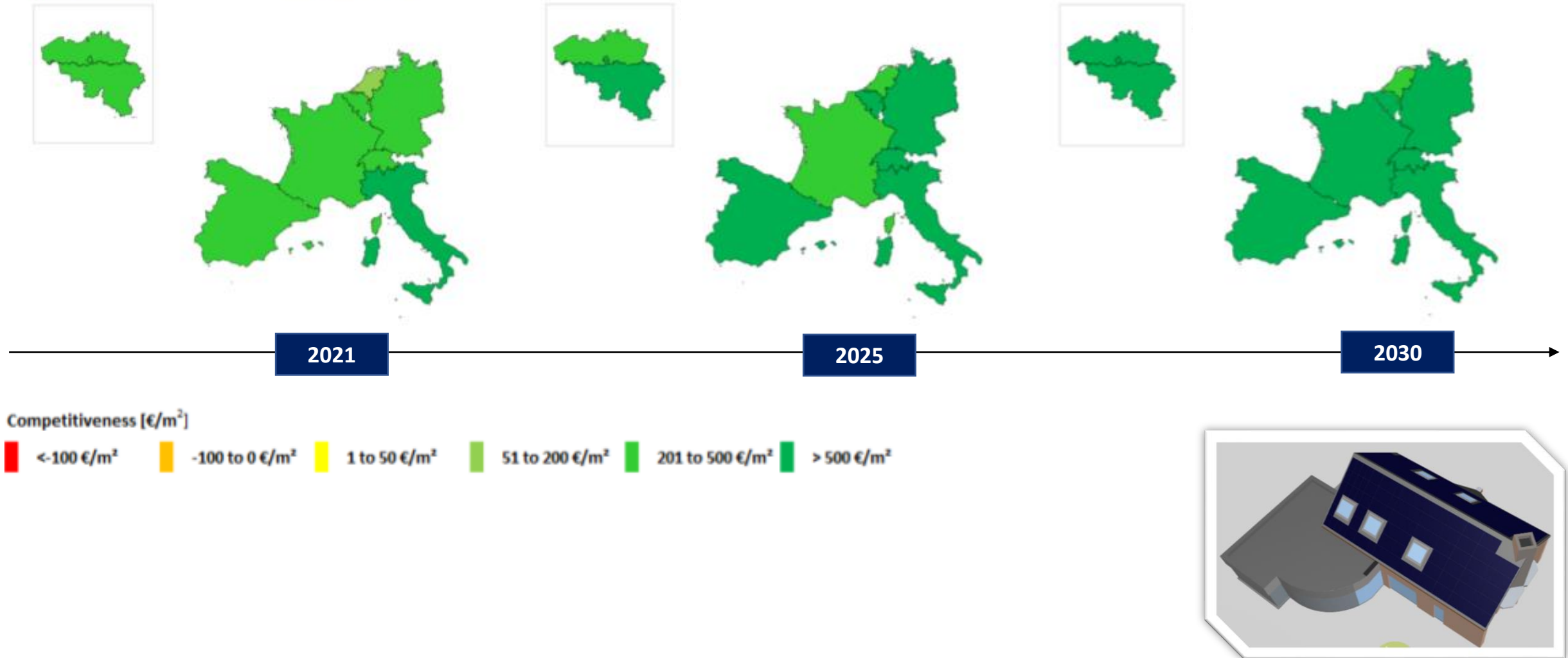
- From the BIPV sector

- economies of scale and industrialization*

- Overall, both **market-pull** and **technology-push** is required in order to effectively achieve all/most expected impacts of the above improvements.

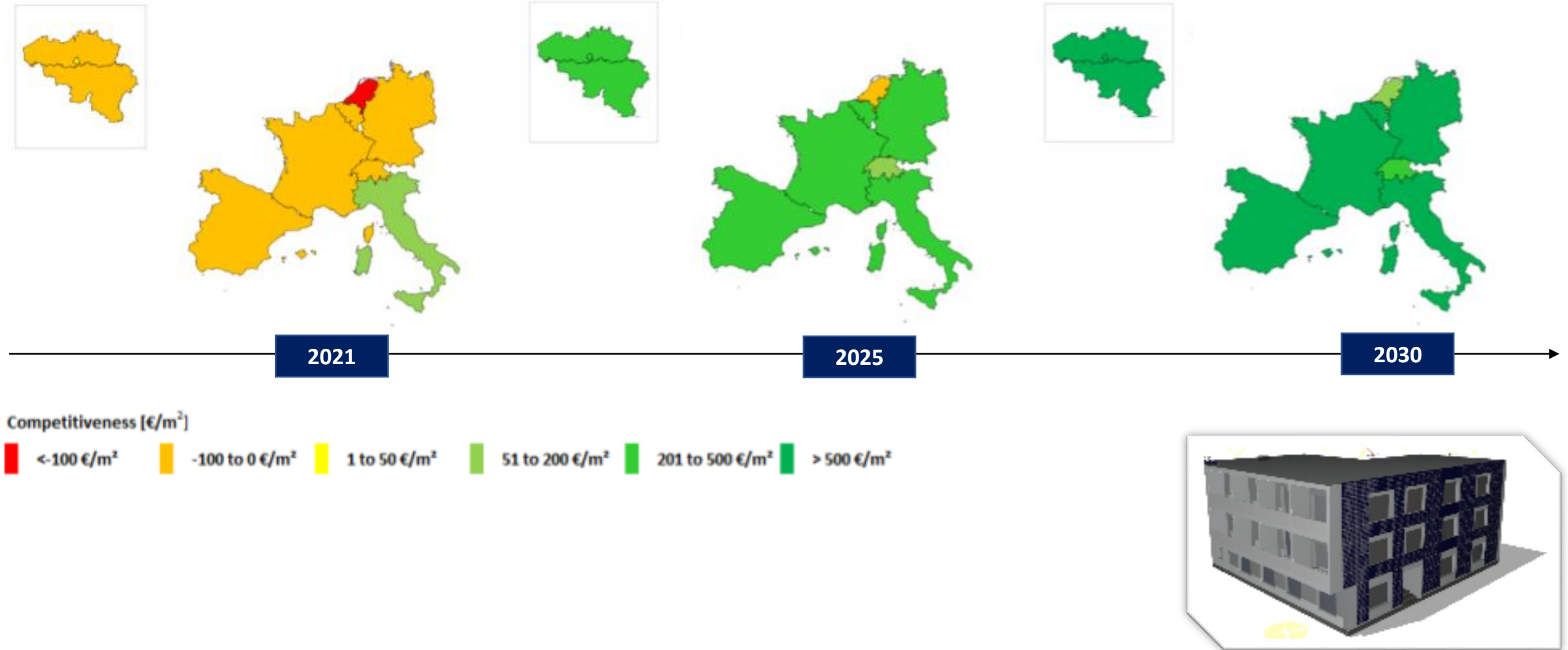
The competitiveness of SFH with BIPV should be further enhanced

Single-family houses with BIPV roof



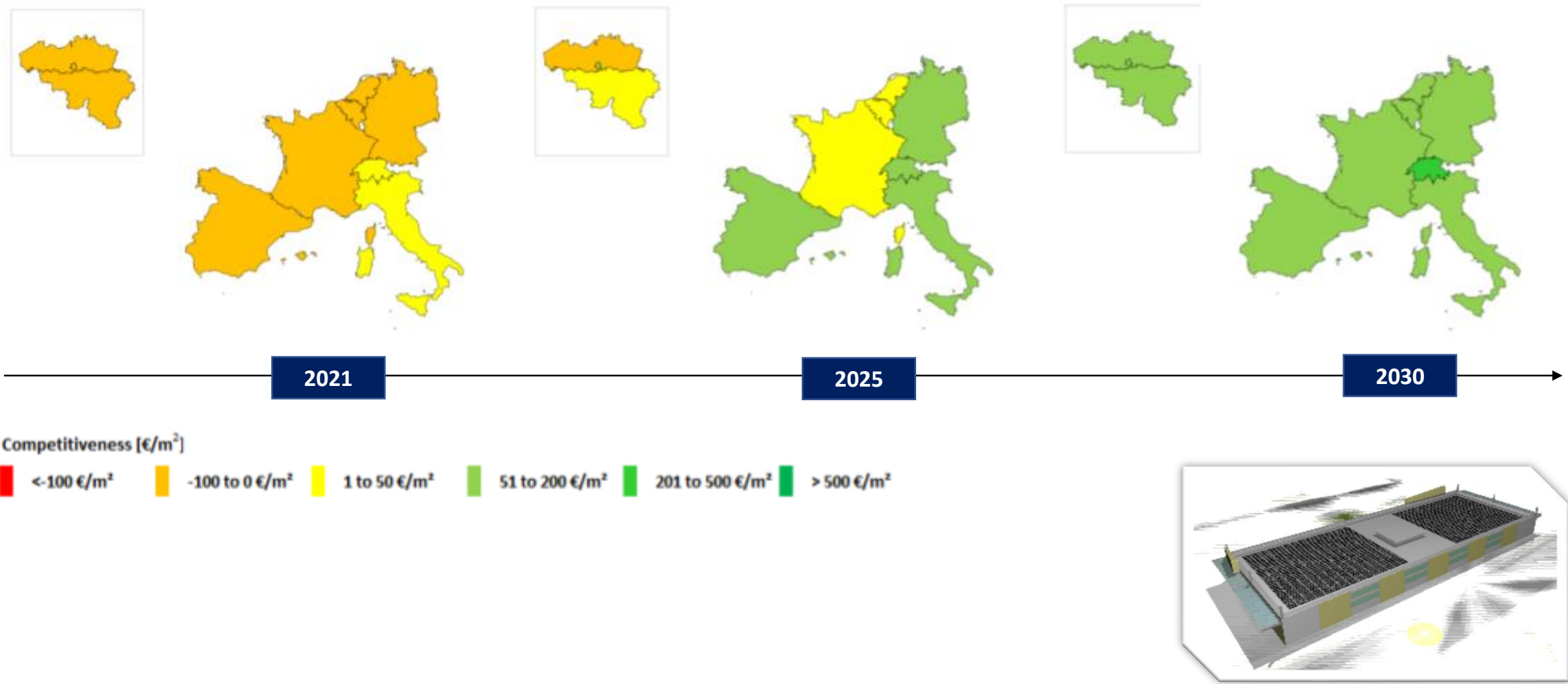
MFH with BIPV should become competitive in all locations between 2025 & 2030

Multi-family houses with ventilated BIPV façade



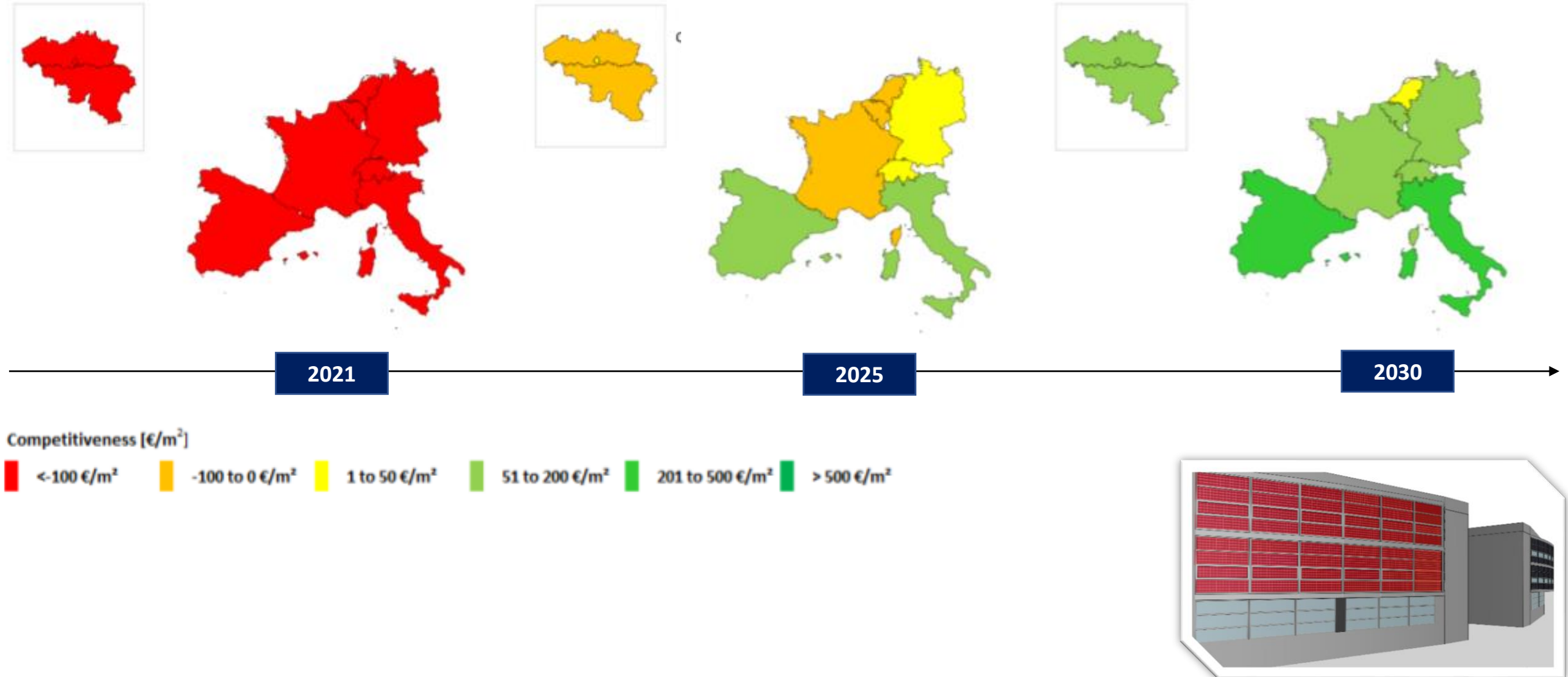
IB with BIPV should be competitive in all locations by 2025

Industrial building with BIPV roof



OB with BIPV should become competitive in all locations just after 2030

Office building with non-ventilated BIPV façade





Key Takeaways



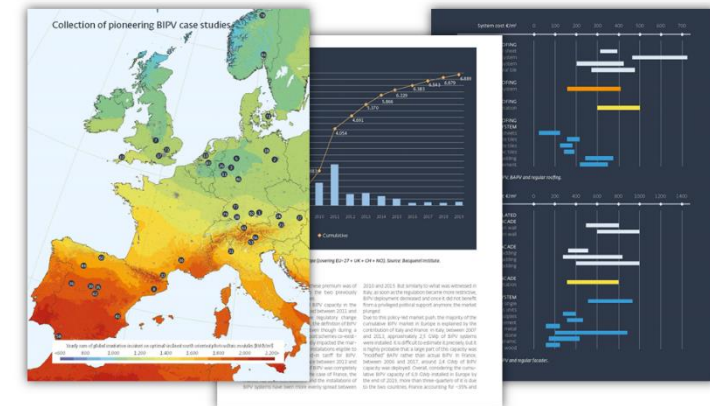
BIPV is already cost competitive under certain conditions

- BIPV offers a **wide range of possibilities** in terms of area it can be integrated to: shapes, size, colors, transparency, ...
- BIPV is **already competitive** in some segments and locations
- **BIPVBOOST innovations** will significantly contribute to **reduce the cost** of BIPV solutions along the value chain
- But additional improvements driven by market-pull and technology-push from the **PV, BIPV** and **construction sectors** are also essential, as well as **regulators** !
- 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?



Download the full technical reports at
www.bipvboost.eu



BIPV Status Report 2020



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