



BE  MART

Together for Active and Efficient Buildings

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The BE-Smart project has received funding from The European Union's
Horizon 2020 research and innovation programme under grant agreement
No 818009.



Performance assessment of BIPV systems: research on characterization methods

1. BIPV market transfer and quality needs

2. State of art and missing gaps in BIPV qualification framework

3. Towards a new approach for BIPV performance assessment

4. Conclusions





BIPV architecture

+40 years of evolution

“Architects encounter several problems when designing PV buildings. One of the main problems is that PV systems do not correspond with building sizes. ... the colours and sizes of PV panels are too limited.”

Literature survey and analysis of nontechnical problems for the introduction of BIPV,
Task 7 IEA PVPS, 1999

“Nobody can know that it is a solar-powered house.”

Architect Erika Fries, HUGGENBERGERFRIES Architects, 2018

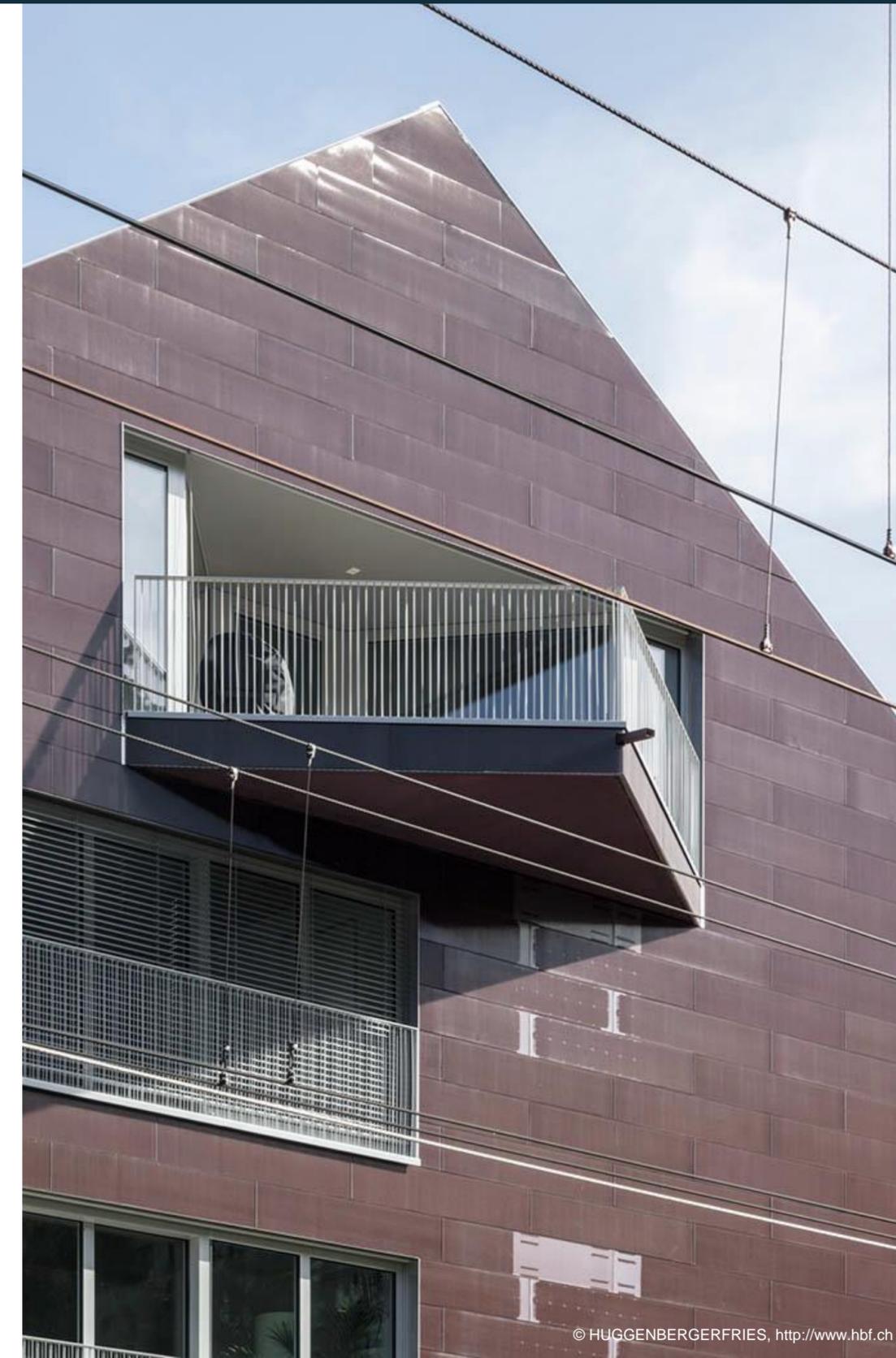


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SOLARCHITECTURE
sun as a building material

www.solarchitecture.ch

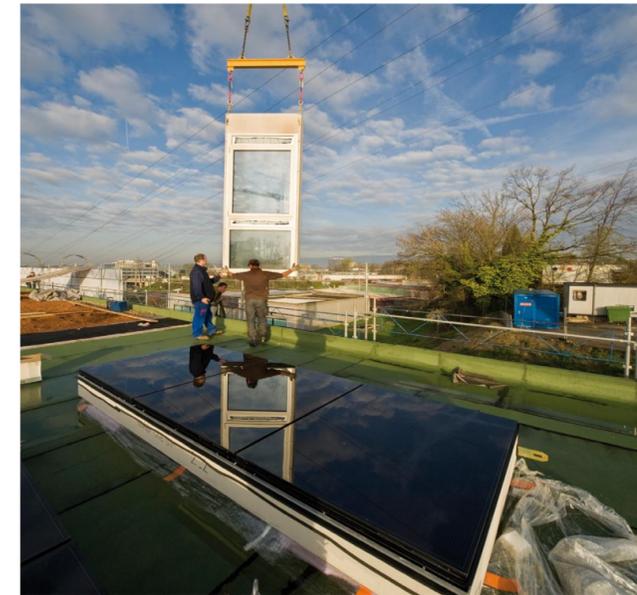




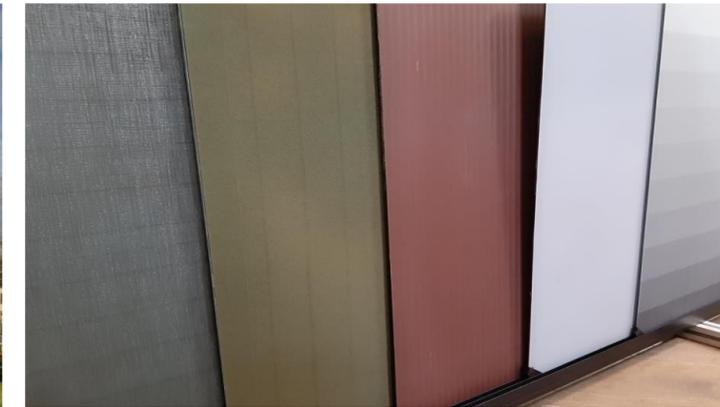
BIPV technology

dynamics of innovation

- Multifunctional facades and roofs
(PV is ...building skin)
- Opaque and transparent products
(mimicry, evident or invisible)
- Standard towards customized
(mass-production and tailor-made design)
- Flexibility and automation
(Automatic, self-configurable production)
- Integrated process management
(data-driven chain from design to O&M)



(source: Faceactive-Batineg)



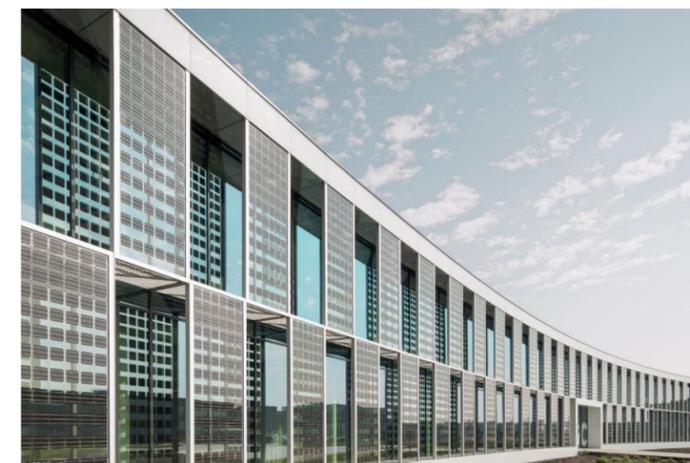
Coloured modules (photo: P. Bonomo)



Lightweight system (source: Suolar Retrofit SA)



(source: Compaz)



(source: AG Technovation center, Gosselies, Belgium)



(source: Kamaleon Solar)



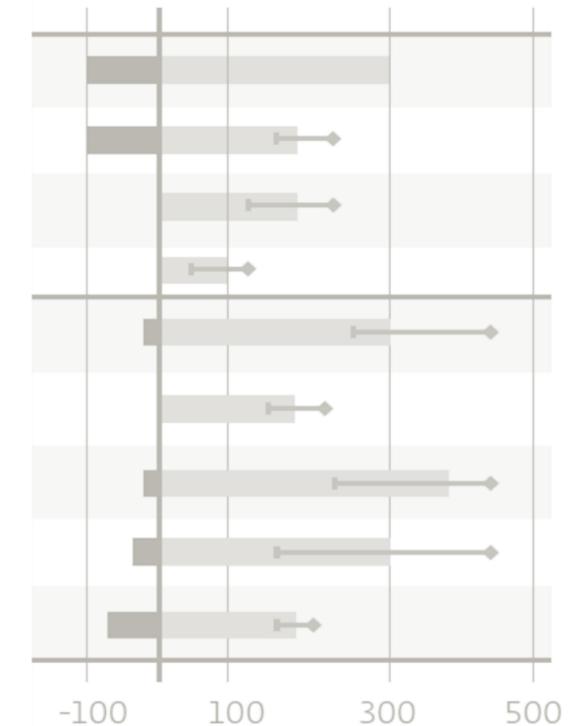
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How to boost market Implementation?

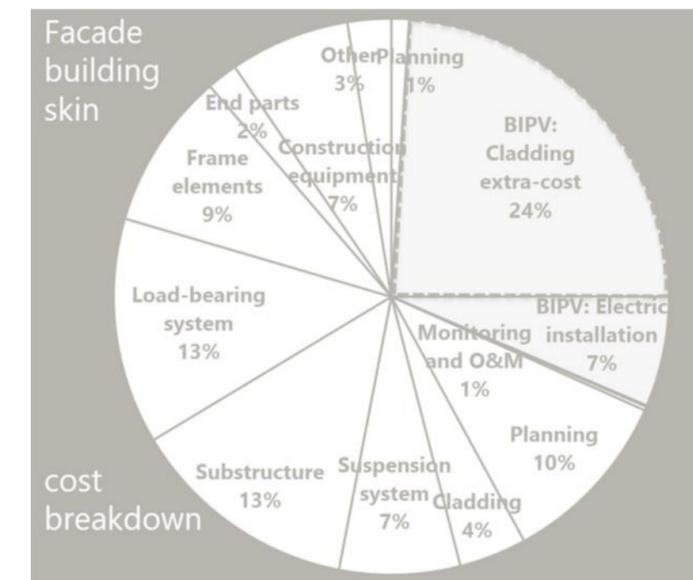
“(BI)PV is locked in a critical “chicken-and-egg” situation between price and economy of volume. The prices are too high to generate a substantial market and a market is needed to generate economy of scale”

Literature survey and analysis of nontechnical problems for the introduction of BIPV, Task 7 IEA PVPS, 1999



“Develop BIPV elements, to entirely replace roofs or facades and reduce their additional cost by 50% by 2020, and by 75% by 2030 compared to 2015 levels”

SET-Plan – Declaration on Strategic Targets in the context of an Initiative for Global Leadership in Photovoltaics (PV), 2016



www.bipvboost.eu



REFERENCES:

P. Corti et al, *Method for the cost evaluation of BIPV facades and multilevel cost analysis of six Swiss case studies*. 21. BRENET Status-Seminar, 2020
Status Report SUPSI Bequerel 2020- www.solarchitecture.ch



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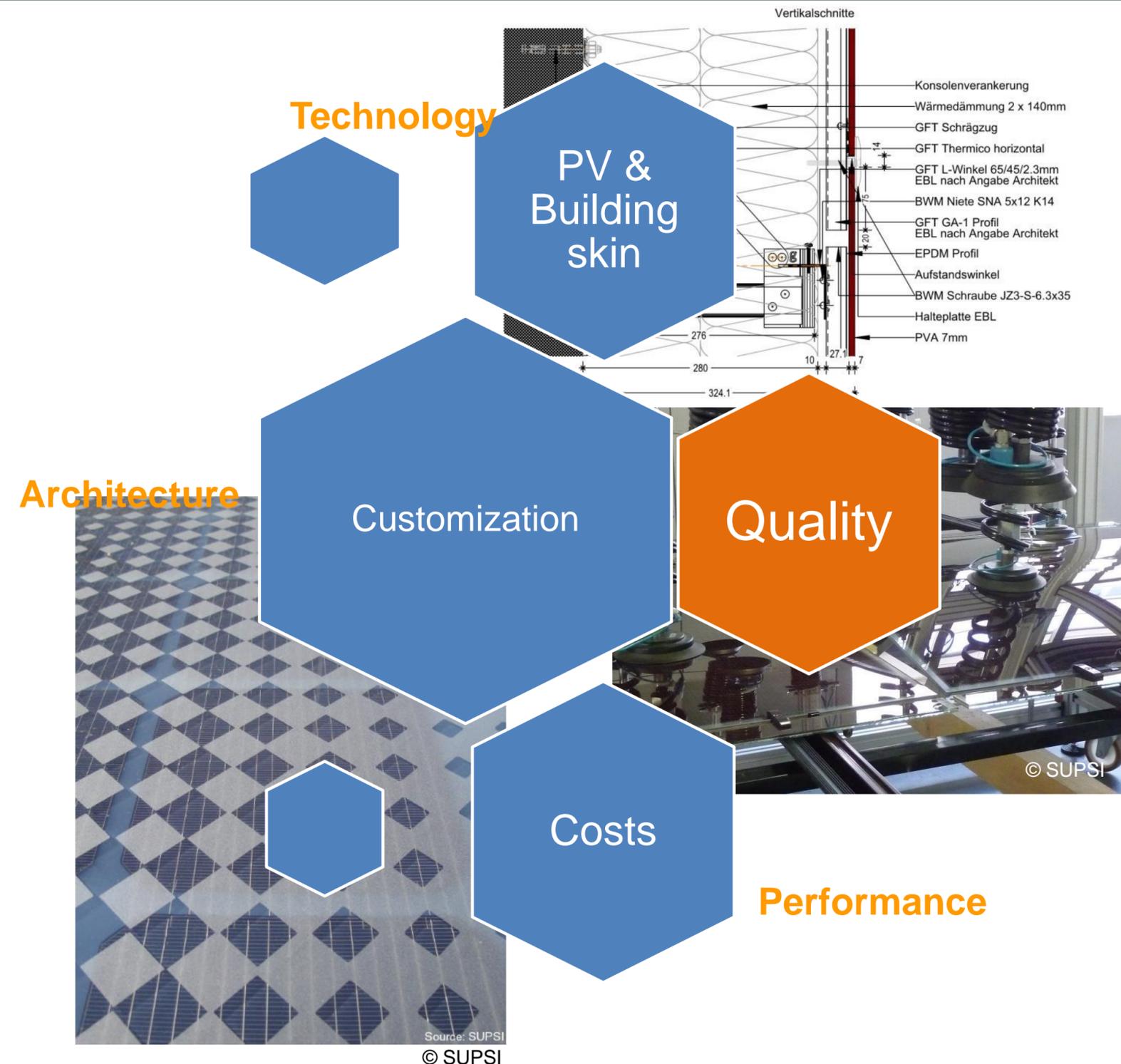
What for market transfer?

- **BIPV > Quality of a multifunctional system**
Safety (mechanical, fire), durability, etc.
- **BIPV > Standards compliance**
Qualification as a PV active building product
(CPR 305/2011 and LVD 2014/35/UE CE Marking,
local building codes ...)

Performance of a BIPV system may significantly differ from a traditional construction system or PV module.

PV+BUILDING is not BIPV: the sum is not enough!

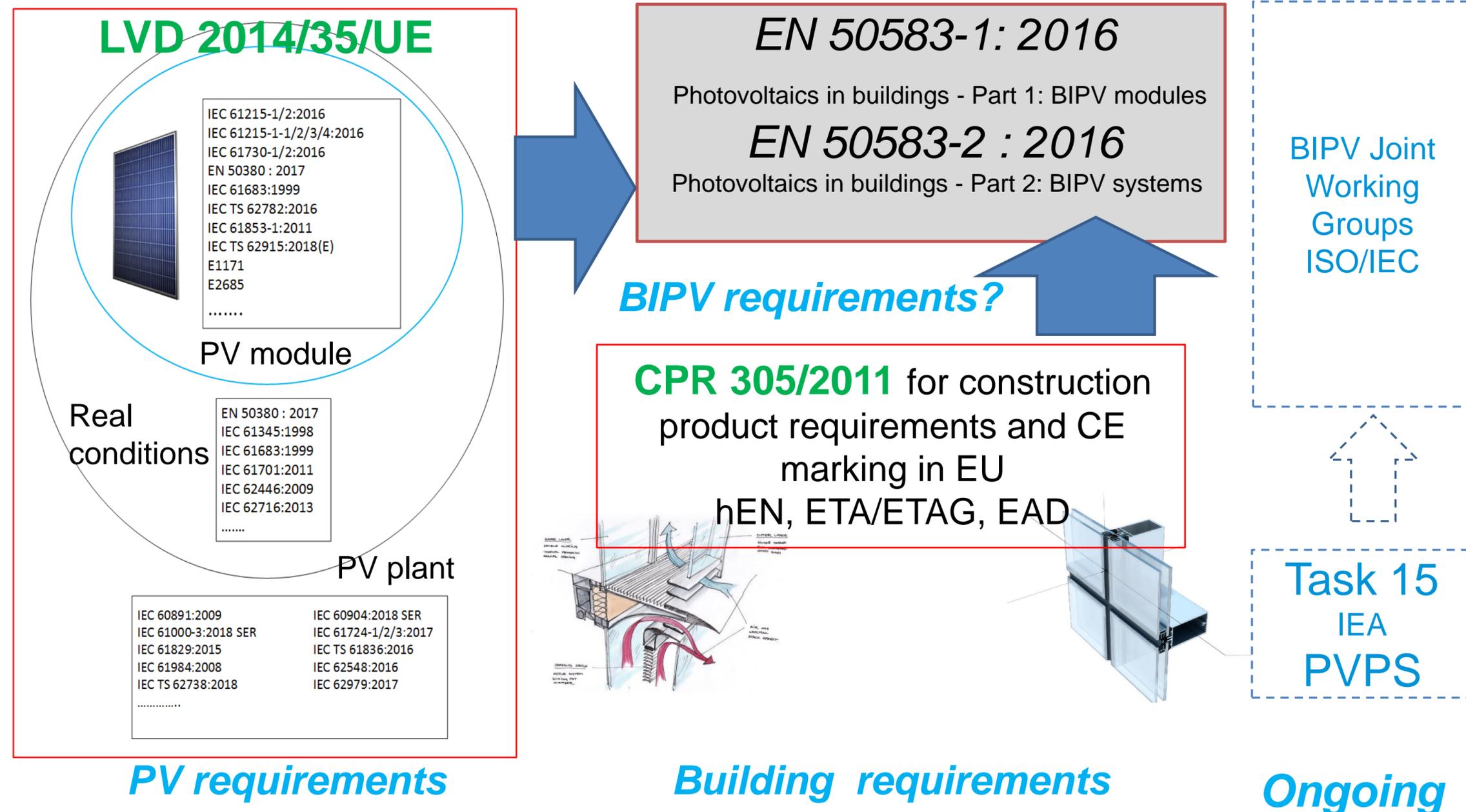
The real obstacle to the market is very practical: the uncertainty due to the lack of harmonized rules, and integrated performance assessment approaches





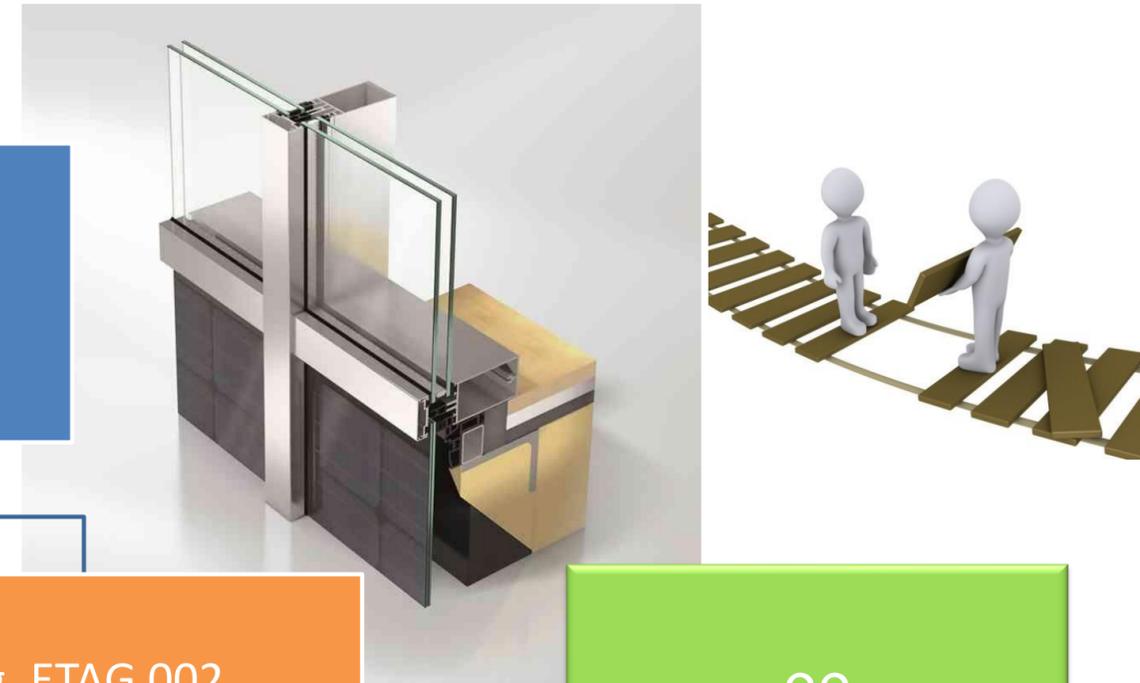
State of art: fragmented framework

- BIPV normative framework not harmonized in EU
- Current approach (**LVD+ CPR**) fragmented and costly
- PV and building norms and requirements not integrated
- Current market based on case-by-case responsibility
- **Uncertainty:** obstacle for a real EU market pull
- **Risk for quality** (a potential market kill?)





What's the result in practical terms?



Technical assessment in a "double" (construction+PV) framework:

- Lack of BIPV requirements
- Redundancy of requirements
- Influenced requirements (PV and construction interact)



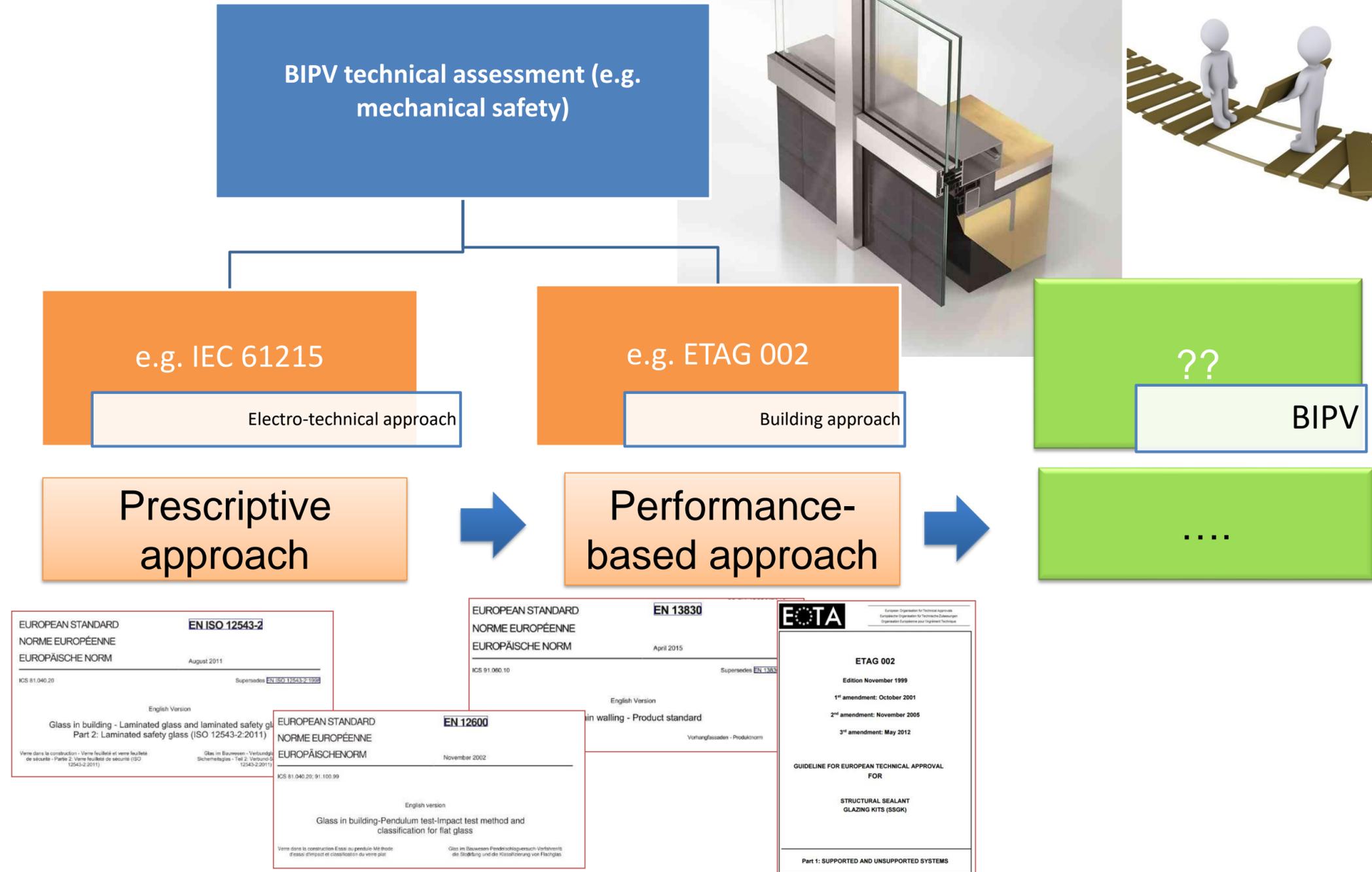
Not clear framework



Niche market (big projects):
High cost/long time for certification

Mass market:

NO BIPV due to uncertainties
Assume risks with interpretation



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Towards a new approach for BIPV qualification

How can we support BIPV market with a new qualification approach?

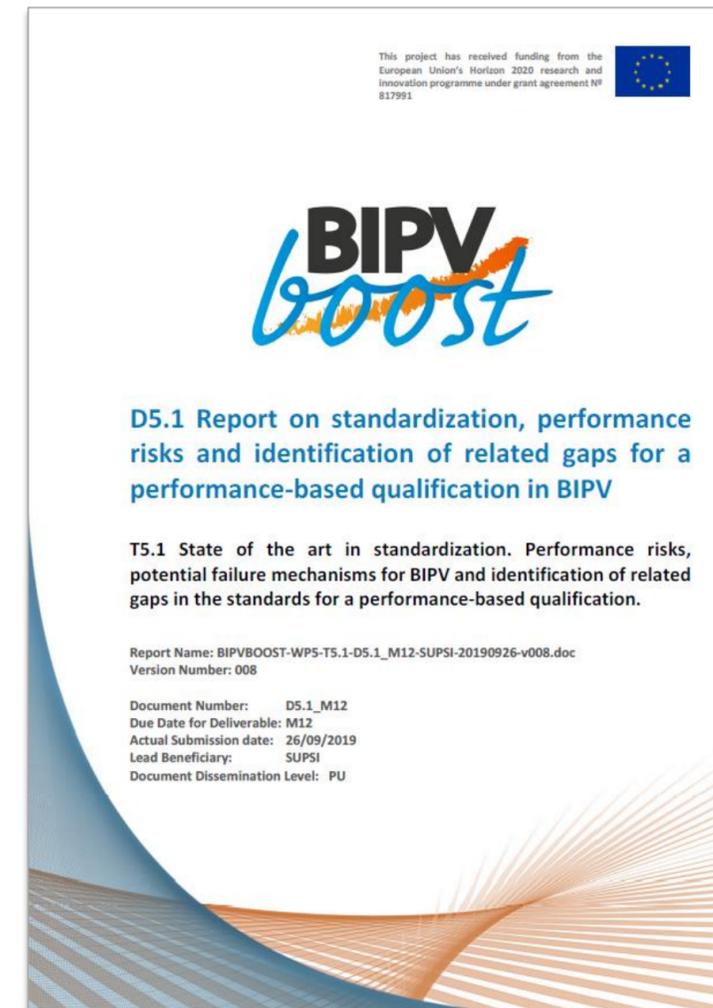
GOAL 1:

Set some new **experimental approaches** for technical test procedures for BIPV based on:

- Performance-based approach
- Limit states (LS) definition
- Combined PV and construction requirements
- Cost-effectiveness

GOAL 2: Overcome some missing gaps by providing new **performance specifications on BIPV requirements**

Definition of new LS, performance assessment and testing procedures based on **interdisciplinarity**

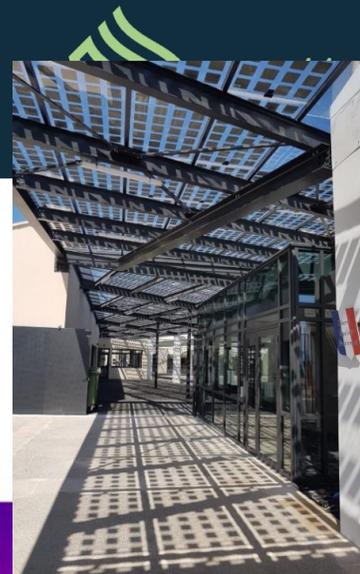


Deliverable D5.1-M12

D5.1 Report on standardization, performance risks and identification of related gaps for a performance-based qualification in BIPV

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Towards a new approach for BIPV quality

Reference methodology/workflow:

Starting point: PV and building current standards

Methodology:

- Analysis of relevant technical requirements in cross-comparison of building and PV standards
- Determination of missing, redundant or incomplete requirements for BIPV
- Decision on the need of add/improve a BIPV requirement for LS/PBA
- *Feedback* from industries and arch./engineers
- Execute test campaigns for validation



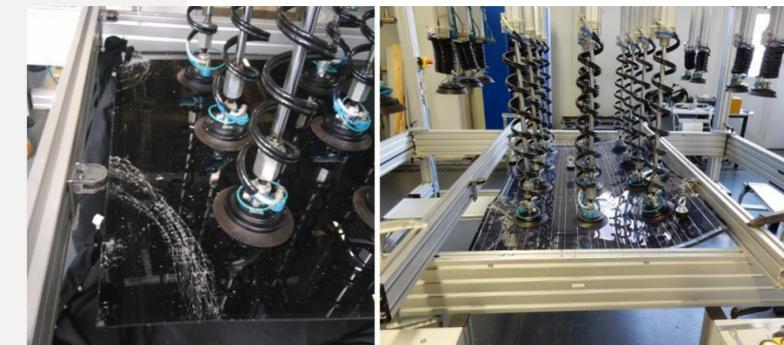
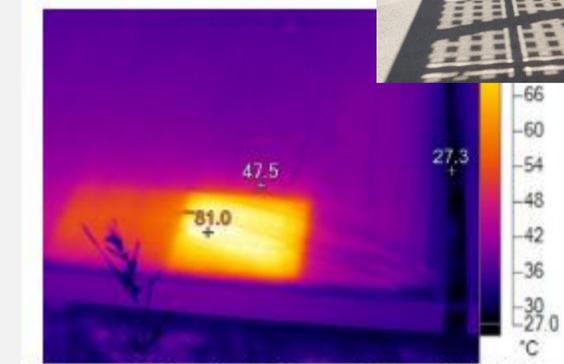
Key-requirements

Energy economy (EE)

Electrical safety in non-conventional scenarios

Mechanical safety and performance

Fire reaction of BIPV components/systems





BIPV Energy Economy

Determination of thermal transmittance (U value)

- Laminated/Insulated PV glass
- Assess the impact of the different BIPV features (cells, JB, cablings) and provide new calculation criteria

Determination of solar gain (g value)

- Laminated/Insulated PV glass
- Assess the impact of the different BIPV features (cells position, ratio, etc.) and provide new calculation criteria

Energy economy (EE): Energy Performance of Buildings (EPB)

- Assess the impact of PV glazing as “dynamic transparent element” (electric/thermal/optical) in calculation of EPB and proposal of new calculation criteria





BIPV Electrical safety

Thermal behaviour in non-conventional scenarios due to shading effects

- assess the maximum temperatures of BIPV products in non-conventional shadowing scenarios

Electrical insulation and durability of insulating materials in non-c.s.

- determine the BIPV electrical insulation resistance in combination with the ageing UV and HF sequences, relevant for its mounting application category and temperature range

Suitability of protection devices (bypass diodes) in non-c.s.

- Assess the suitability of thermal design and relative long-term reliability of bypass diodes under a combined thermal stress



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Reference:
Bonomo, P. et.al. (2020) PERFORMANCE ASSESSMENT OF BIPV SYSTEMS: RESEARCH ON BIPV CHARACTERIZATION METHODS. In: EUPVSEC 2020



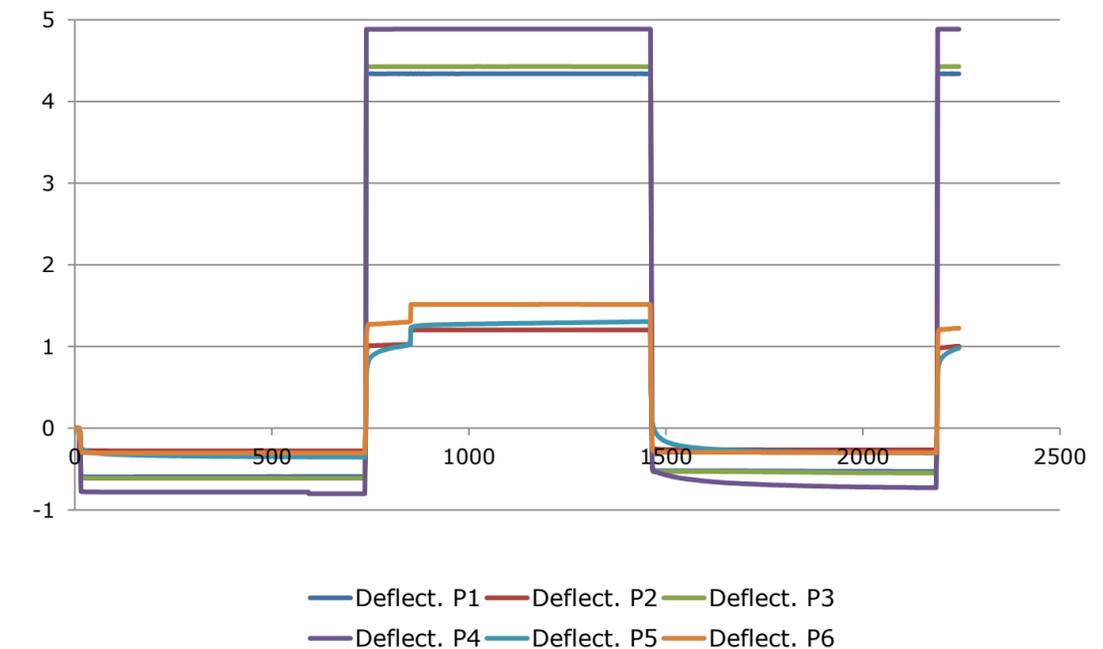
BIPV Mechanical safety

Combined construction & electrical assessment during mechanical stress

- define/assess the “BIPV” threshold performance for construction and electrical parts (e.g. mechanical rigidity and deflection) as suitable in operative conditions
- mechanical load at different environmental scenarios

Combined construction & electrical assessment during impact

- define/assess the “BIPV” integrity/safety thresholds for construction and electrical parts (e.g. mechanical rigidity and deflection) as suitable in ultimate/safeguard conditions
- assess the construction and electrical in the product ULS
- Impact resistance at different environmental scenarios



source: SUPSI

Reference:

P. Bonomo, F. Parolini, F. Frontini, *Safety of laminated BIPV glasses: progresses towards product qualification*, Engineered Transparency Conference 2020, under publishing



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BIPV Fire Safety

Fire reaction of BIPV components/systems

Test procedure with active elements (with/without electrical load) focused on a specific fire safety test (e.g. SBI) for different product category (e.g. façade, roof systems)

- Investigate current missing gaps for describing BIPV fire behavior due to BIPV (e.g. electrical) critical parts.
- Identification of BIPV specific features (e.g. high operating temperature, cabling, electric part interaction) for fire safety.
- The purpose of this work is to suggest new procedures, adapted to BIPV components under fire reaction standard test



source: SUPSI



source: CSTB



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Conclusions

- The construction of **multifunctional BIPV products**, involves the use of several materials that must coexist in the same construction component.
- These elements, electrically active and non-active, assembled together, mutually induce and **influence changes** both in **energy** and in the **construction performance**
- At the state of art of BIPV quality assessment is based on the application of the test **methodologies provided separately by the PV or the building** regulations.

BI (building) + PV (photovoltaics) ≠ BIPV

- A **harmonized technical/normative approach** for BIPV is needed
- Next activities of BIPVBOOST project group will be aimed at progressing on the research and development of **new qualification procedures for BIPV** performance assessment towards an integrated approach.





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The project BIPVBOOST has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 817991.

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**Thank you
for your attention.**