ZAG ZAVOD ZA GRADBENIŠTVO SLOVENIJE — SLOVENIAN NATIONAL BUILDING AND CIVIL ENGINEERING INSTITUTE

FRISSBE fire-safe sustainable built environment

SBRA Slovenian Business & Research Association Slovensko gospodarsko in raziskovalno združenje

Mind the EPD Harmonization Gap!

New fire risks from electrification and renovation of buidings

Brussels, 03/10/2025

Fire safety of BIPV

tecnalia MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

Source: Tecnalia
Public reports - BIPV Boost

tecnalia
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

What is IEA PVPS?

Established in 1993, the Photovoltaic Power Systems programme is one of the **Technology Collaboration Programmes (TCPs)** within the International Energy Agency.

How is it organised?

- IEA PVPS is organised according to joint research projects, called **"Tasks"**.
- The members select the Tasks they wish to participate in and delegate their **experts** to contribute to the work.
- The Tasks publish **technical reports** and conduct workshops and webinars.
- The **Executive Committee Delegates** oversee and direct the programme, ensuring the relevancy of work and quality of publications.

UK and India have recently joined the programme

Our members

- Australia
- Austria
- Belgium
- Canada
- China
- Denmark
- Enercity
- European Union
- Finland
- France
- Germany
- Israel
- Italy
- Japan
- Korea
- Malaysia
- Morocco
- the Netherlands
- Norway
- Portugal
- Solar Energy Research Institute of Singapore
- Solar Power Europe
- South Africa
- Spain
- Sweden
- Switzerland
- Thailand
- Türkiye
- United States

IEA PVPS TASK 15

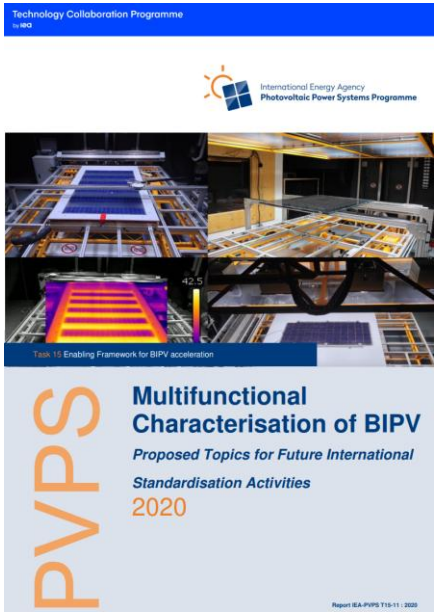
Enabling Framework for the Development of BIPV

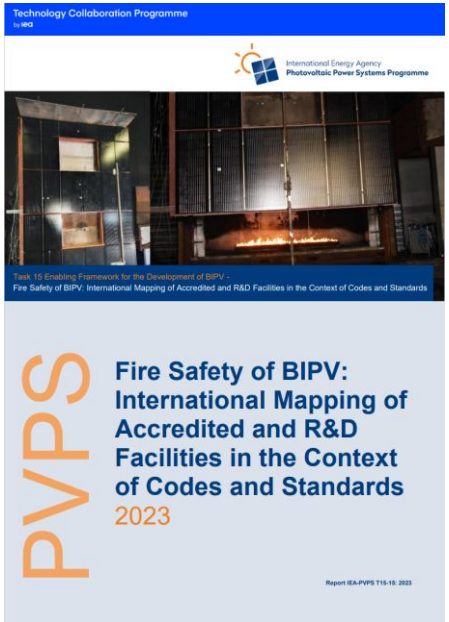
Mission (2024-2027):

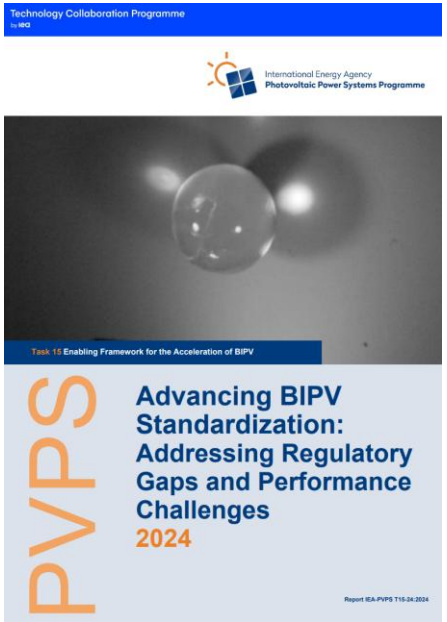
to build a comprehensive technical, regulatory, educational, digital and market infrastructure, so that **BIPV can be widely adopted** as a mainstream, multifunctional, and aesthetically integrated building solution.


Source: SUPSI (CH)

Reports and factsheets







[Publications - IEA-PVPS]

Scientific Articles

A state-of-the-art review of fire safety of photovoltaic systems in buildings
M Aram, X Zhang, D Qi, Y Ko - Journal of Cleaner Production, 2021

Fire safety requirements for building integrated photovoltaics (BIPV): A cross-country comparison
R Yang, Y Zang, J Yang, R Wakefield, K Nguyen, L Shi… - Renewable and Sustainable Energy Reviews, 2023

Fire safety of building integrated photovoltaic systems: Critical review for codes and standards
Y Ko, M Aram, X Zhang, D Qi - Indoor and Built Environment, 2023

IEA PVPS TASK 15

Enabling Framework for the Development of BIPV

Task 15: 2016-2019

- BIPV project database
- Transition towards Sound BIPV Business Models
- International framework of BIPV specifications
- Environmental Benefits of BIPV

Task 15: 2020-2023

- TIS Analysis of BIPV
- Cross-sectional analysis
- BIPV Guidelines
- Digitalization for BIPV
- Pre-normative international research on BIPV

Task 15: 2024-2027

- BIPV market and in circular economy
- Pre-Standardization
- Digital environment
- Product, demo and long-term behavior

Activity B1: Fire Safety of BIPV

BIPV specific standards need to be developed

- **Electrical and construction** related standards and regulations have been **running in parallel**, but on the last years some initiatives are trying to bring closer both knowledge fields.
- BIPV products/systems usually **not clearly included in standards and regulations**. E.g. no clear path for CE marking for BIPV products or BIPV products not included in building codes.
- BIPV products have different operating conditions compared to other passive products, so tests should take into account these **operating conditions**.
- **BIPV** for façade claddings use is the **most interesting topic** for activity participants.

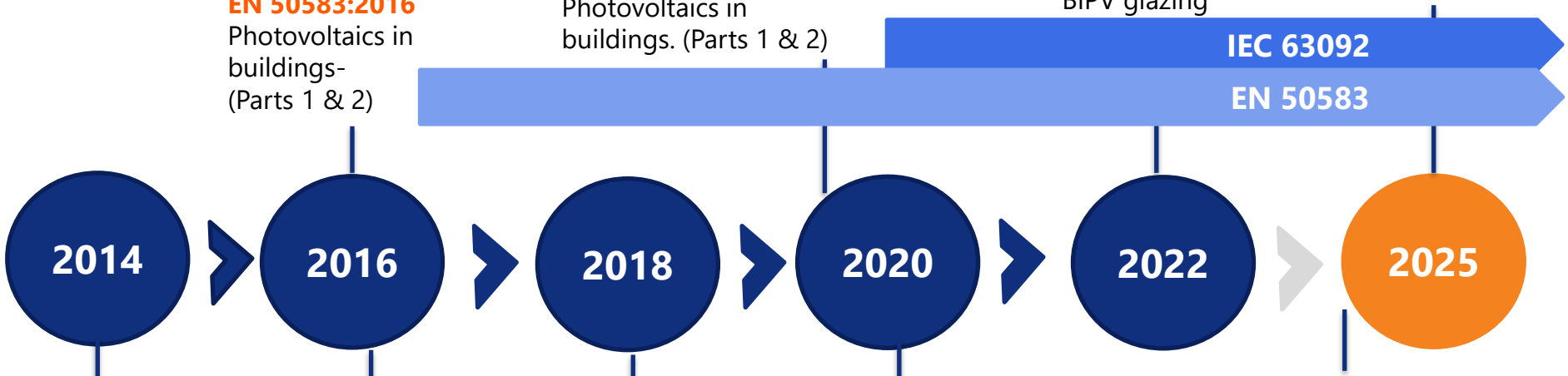
Evolution of BIPV standards

2016:
EN 50583:2016
Photovoltaics in buildings- (Parts 1 & 2)

2020:
IEC 63092:2020
Photovoltaics in buildings. (Parts 1 & 2)

2024:
EN 410 (rev)
Determination of luminous and solar characteristics of glazing. Annex E for BIPV glazing

2025
EN 50583 part 1 (rev)
New annexes including BIPV specific features (fire, impacts, partial shadowing, etc.)



2014:
pr IEC 62980:
Photovoltaic modules for building curtain wall applications

2017:
pr **IEC 62980** cancelled.
pr IEC 63092 launched.

2018:
ISO/TS 18178:2018
Glass in building - Laminated solar photovoltaic glass for use in Buildings

2021:
- Revision **EN 50583**
- **ISO/IEC JWG 11** launched Building-Integrated Photovoltaics (BIPV)

2025
IEC 63092 (rev)
Fusion between ISO/TS 18178 & IEC 63092 part 1 (rev)
Photovoltaics in buildings. SHGC coefficient for BIPV (Part 3 rev)

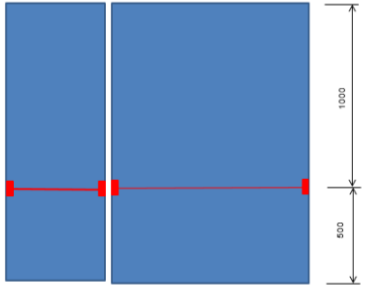
Coordination is Key!

- **JWG 11** between IEC TC 82 (Solar PV) & ISO TC 160 (Glass in buildings) should be **the reference** for other similar initiatives and lead the way.
- Maybe **other JWG are needed**, e.g. CLC TC 82 (solar PV) & CEN TC 129 (glass), and collaboration with other topic specific committees like CEN TC 127 for fire safety will be desirable.
- In addition, **EOTA** (EU organisation for technical assessments) or **EGOLF** (EU association of fire labs) could also be relevant entities to contact with.
- Practical example; EN 50583-1 is under revision now and will include a specific annex for SBI mounting & fixing provisions and direct application of test results. Experts from **CEN TC 127 have made contributions individually**, but sharing the draft document with all the members of the corresponding WG4, will increase the quality of the documents and **support the harmonisation process**.

Several issues when applying existing standards

- Tests performed according to **standard test** methods (e.g. EN 13823 SBI or CEN TS 1187 Broof) present several issues.
- **Sample size** always an issue (e.g. small glazed elements cannot be tempered or bigger elements do not fit in the test bench).
- **Number and location of combustible** materials inherent to BIPV systems not defined (junction boxes, connectors, cable length, etc.).
- Sample **configuration not well defined** (e.g. fixing method, open joints or overlapping elements, cavity size, etc).
- **Sample orientation** in the test (vertical/horizontal) also important to get valid results, e.g. cone calorimeter tests when glazing breaks.
- **Seamless PV (HEU project)** will work on the topic. Results – Seamless-PV

Source: TECNALIA (ES)
ENSNARE H2020 project
Dissemination - ENSNARE

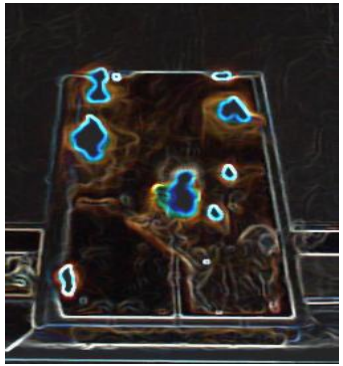


Source: DIBt (DE)
Cornerstones for testing rear-ventilated PV modules

Does energization affect fire performance?

- Current building standards do not consider how **operating conditions** could affect fire performance of BIPV solutions. They are developed for passive systems rather than **active systems**.
- Few studies have been performed so far, but initial results indicate that **energization may accelerate ignition and flame spread** of BIPV.
- So far, tests have been performed connected to an **electrical power supply unit**, but the challenge will be to irradiate the test specimen with artificial light source, to create **more realistic scenario** of energy generation in the system.
- Energization surely affects to **other properties** (mechanical, durability, optical, etc.).
- More **research is needed** on the topic.

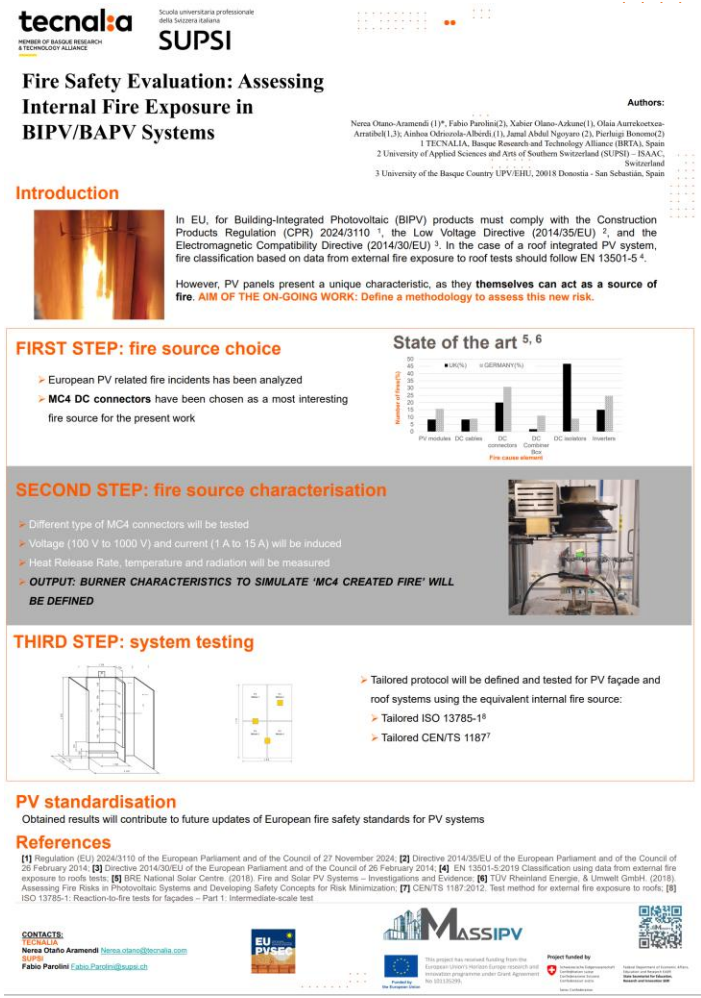
Source: RISE (NO)
SBiPV project
10.1109/PVSC59419.2025.1132477



Source: TECNALIA (ES)
Measuring Envelope systems for Zero Energy buildings | MEZeroE
https://doi.org/10.3390/fire8030105

How we evaluate the risk of internal fires?

- Normally external fire scenarios are evaluated for BIPV systems, but for these solutions **internal fire scenarios** are most likely. How we deal with that?.
- **Cavity behind the PV** panel is critical for the development (or not) of the initial fire in the JB, connector, cables, etc.
- **Mass IPV (HEU project)**; European PV fire incidents have been evaluated, **MC4 connectors** identified as possible source, **fire scenario** in MC4 connectors will be measured and the aim is to **develop a burner/equipment** to reproduce the scenario as best as possible to finally include the **new test method** in the standardisation process.



tecnalia MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

Scuola universitaria professionale della Svizzera italiana SUPSI

Fire Safety Evaluation: Assessing Internal Fire Exposure in BIPV/BAPV Systems

Authors:

Nerea Otano-Aramendi (1)*, Fabio Parolini(2), Xabier Olano-Azkune(1), Olaia Aurrekoetxea-Arratibel(1,3); Ainhoa Odriozola-Alberdi (1), Jamal Abdul Ngoyan (2), Pierluigi Bonomo(2)
1 TECNALIA, Basque Research and Technology Alliance (BRTA), Spain
2 University of Applied Sciences and Arts of Southern Switzerland (SUPSI) – ISAAC, Switzerland
3 University of the Basque Country UPV/EHU, 20018 Donostia - San Sebastián, Spain

Introduction

In EU, for Building-Integrated Photovoltaic (BIPV) products must comply with the Construction Products Regulation (CPR) 2024/3110 [1], the Low Voltage Directive (2014/35/EU) [2], and the Electromagnetic Compatibility Directive (2014/30/EU) [3]. In the case of a roof integrated PV system, fire classification based on data from external fire exposure to roof tests should follow EN 13501-5 [4].

However, PV panels present a unique characteristic, as they **themselves can act as a source of fire**. AIM OF THE ON-GOING WORK: Define a methodology to assess this new risk.

FIRST STEP: fire source choice

- European PV related fire incidents has been analyzed
- **MC4 DC connectors** have been chosen as a most interesting fire source for the present work

State of the art [5, 6]

SECOND STEP: fire source characterisation

- Different type of MC4 connectors will be tested
- Voltage (100 V to 1000 V) and current (1 A to 15 A) will be induced
- Heat Release Rate, temperature and radiation will be measured
- *OUTPUT: BURNER CHARACTERISTICS TO SIMULATE 'MC4 CREATED FIRE' WILL BE DEFINED*

THIRD STEP: system testing

- Tailored protocol will be defined and tested for PV façade and roof systems using the equivalent internal fire source:
  - Tailored ISO 13785-1[8]
  - Tailored CEN/TS 1187[7]

PV standardisation

Obtained results will contribute to future updates of European fire safety standards for PV systems

References

[1] Regulation (EU) 2024/3110 of the European Parliament and of the Council of 27 November 2024; [2] Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014; [3] Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014; [4] EN 13501-5:2019 Classification using data from external fire exposure to roofs tests; [5] BRE National Solar Centre. (2018). Fire and Solar PV Systems – Investigations and Evidence; [6] TÜV Rheinland Energie. & Umwelt GmbH. (2018). Assessing Fire Risks in Photovoltaic Systems and Developing Safety Concepts for Risk Minimization; [7] CEN/TS 1187:2012. Test method for external fire exposure to roofs; [8] ISO 13785-1: Reaction-to-fire tests for façades – Part 1: Intermediate-scale test

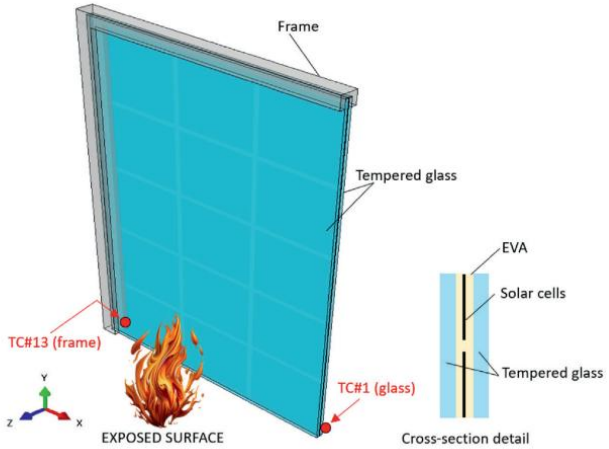
CONTACTS:
TECNALIA:
Nerea Otaño Aramendi Nerea.otano@tecnalia.com
SUPSI:
Fabio Parolini Fabio.Parolini@supsi.ch

MASSIPV

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101192909.
Project funded by

Lack of test and simulation data

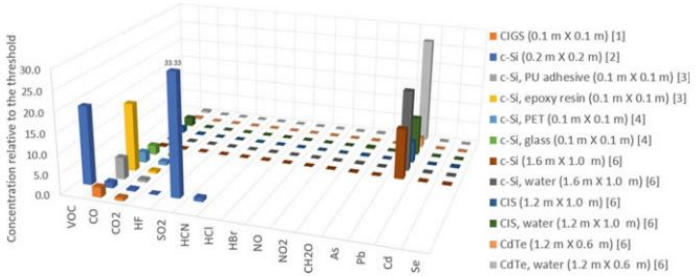
- **Fire engineers are missing data** from tests and simulation models in order to perform fire safety engineering studies of BIPV projects.
- Experimental **data mainly exist for BAPV** systems, less for BIPV.
- **Lack of data in simulation softwares** (e.g. FDS) for PV panel materials. Instead, panel itself is modeled as the fire source and its HRR curve (heat release rate) matched, to align with test results.
- Identifying **location for temperature sensors** for model validation is **challenging**, as in some tests they are located in the exhaust duct.



Source: University of Trieste
10.5772/intechopen.1009849
10.1002/eng2.70347

Smoke toxicity and spread

- BIPV modules often contain layers of e.g. polyethylene terephthalate (PET), polymethyl-methacrylate (PMMA) and ethylene-vinyl acetate (EVA)—all of which are **combustible**.
- In fire scenarios, these materials can **release toxic gases** such as:
  - Sulfur dioxide (SO_2)
  - Hydrogen fluoride (HF)
  - Hydrogen cyanide (HCN)
  - Volatile organic compounds (VOCs), etc.



- For certain BIPV solutions (curtain walls, windows, balustrades, etc.) there is a clear **risk of smoke re-entering the building when a fire occurs.**
- So far bench scale tests have been performed, but **product/system scale** tests are needed too.

Source: NRCC (CA)
Fire Risks of Renewable Energy Technologies in Buildings: Analysis of Fire Effluents for Smoke and Toxicant Detection

tecnalia
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

Eskerrikasko zuen arretagatik!
Thank you for your attention!
Gracias por vuestra atención!

For more information: