

PRODUCT CATALOGUE



Bringing down costs of multifunctional building-integrated photovoltaic (BIPV) solutions and processes along the value chain, enabling widespread nZEBs implementation

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 817991

BIPVBOOST results are categorized in four areas:

ADVANCED BIPV MANUFACTURING

BIPVBOOST developed a flexible and automated BIPV module manufacturing line, providing significant cost reductions along the process

- Flexible and Automatic BIPV Module manufacturing and quality control line

DIGITALIZED AND ENERGY MANAGEMENT SYSTEM (EMS) ALONG THE VALUE CHAIN

BIPVBOOST developed a unique digital ecosystem to address every step within the BIPV reference workflow, providing interoperable applications connected to the main BIMsolar digital platform.

BIM is a driver for cost reduction and risk mitigation from design to O&M, including manufacturing

- Cloud-based energy management system for tertiary buildings, including BIPV generation and storage management
- BIPV Digital Twin. Failure Detection and Diagnosis Tool
- Augmented reality to support BIPV implementation since the pre-design stage
- BIM-based software tool supporting the BIPV process design, manufacturing, installation, operation and maintenance
- Digital adoption plan and guideline for a data-driven BIPV process

PORTFOLIO OF COST-COMPETITIVE BIPV SOLUTIONS

BIPVBOOST developed a portfolio of cost-competitive BIPV solutions.

- Portfolio of low-cost and aesthetically advanced glass-glass BIPV products based on c-Si, back contact and a-Si technologies for different applications
- Multifunctional BIPV façade cladding system with integrated insulation
- Low cost Click&Go substructure for BIPV modules
- Enhanced, cost effective BIPV roof and facades systems for CIGS on metal

STANDARDISATION / QUALIFICATION OF BIPV SYSTEMS

BIPVBOOST provided the overview of the current normative framework in BIPV field, the definition of the relevant missing gaps, and the key-aspects for grounding a new testing approach.

- Indoor & outdoor performance-based laboratory testing procedures for BIPV products

TABLE OF CONTENTS

PRODUCT 1 PAGE 4

Flexible and automatic BIPV module manufacturing and control line

PRODUCT 3 PAGE 8

Multifunctional BIPV façade cladding system with integrated insulation

PRODUCT 6 PAGE 14

Cloud-based energy management system for tertiary buildings, including BIPV generation and storage management

PRODUCT 9 PAGE 20

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

PRODUCT 2 PAGE 6

Portfolio of low-cost and aesthetically advanced glass-glass BIPV products based on c-Si, back contact and a-Si technologies for different applications

PRODUCT 4 PAGE 10

Low cost Click&Go substructure for BIPV modules

PRODUCT 7 PAGE 16

BIPV Digital Twin. Failure Detection and Diagnosis Tool

PRODUCT 10 PAGE 22

Indoor & outdoor performance-based laboratory testing procedures for BIPV products

PRODUCT 5 PAGE 12

Enhanced, cost effective BIPV roof and facades systems for CIGS on metal

PRODUCT 8 PAGE 18

Augmented reality to support BIPV implementation since the pre-design stage

PRODUCT 11 PAGE 24

Digital adoption plan and guideline for a data-driven BIPV process

FLEXIBLE AND AUTOMATIC BIPV MODULE MANUFACTURING AND CONTROL LINE

PRODUCT

PRODUCT 1

DETAILS

This line allows compatibility with a broad range of cells (6" mono and polycrystalline silicon cells, and bifacial cells, of 3 busbars (BB), 4BB and 5BB), providing flexibility in the string length and cell distances. It includes automatic string lay-up equipment for string placing, allowing XL formats (3 x 2 m) and accurate and free string positioning onto the module. Semi-manual string interconnection and automatic in-line electroluminescence quality control are possible and compatible with customized and large module formats.

Flexible manufacturing line for glass-glass stations:

The complete flexible manufacturing line for glass-glass BIPV products foreseen in BIPVBOOST project consists of 4 stations:

1. A tabber-stringer equipment for mono and polycrystalline cell interconnection
2. Lay-up machine
3. Interconnection (bussing) station
4. High-resolution electroluminescence quality





PORTFOLIO OF LOW-COST AND AESTHETICALLY ADVANCED GLASS-GLASS BIPV PRODUCTS BASED ON C-SI, BACK CONTACT AND A-SI TECHNOLOGIES FOR DIFFERENT APPLICATIONS

DETAILS

BIPV wide product portfolio offers a cost-competitive aesthetically advanced glass-glass BIPV modules based on c-Si (mono and bifacial), back contact (b-c) and a-Si technologies:

- Semi-transparent glass-glass a-Si patterned glass competing with digital printing
- Low cost, large format and thickness glass-glass bifacial cell modules for balustrade
- Glass-glass b-c walkable floor

A broad range of applications are addressed (curtain wall, balustrade, walkable floor and ventilated façade) offering products with excellent balance in terms of aesthetics, performance and cost.

Semi-transparent glass-glass a-Si patterned glass competing with digital printing

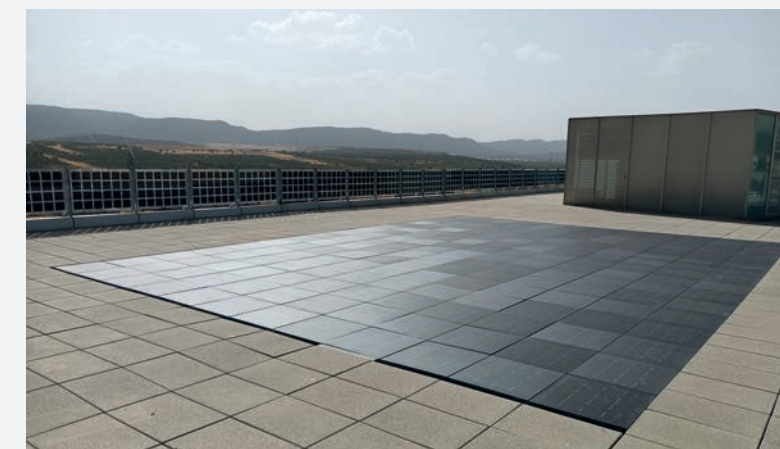
Digital printed glass is a fast-growing and high-margin market for the architectural glass industry, providing large possibilities in terms of aesthetics. On the other hand, laser patterned amorphous Si glass-glass modules provide the opportunity to develop similar products with the added PV production capability, at a similar price. Thus, ONYX has developed low-cost a-Si patterned glass-glass BIPV modules in cost parity with digitally printed glass.

Low cost, large format and thickness glass-glass bifacial cell modules for balustrade

ONYX has applied its former knowledge on bifacial cells and the development of XL format glass-glass modules to develop low-cost bifacial cell modules for integration in balustrades with a minimum thickness of 20 mm to 24 mm, implemented as 10 mm + 10 mm or 12 mm + 12 mm double laminated glass.

Glass-glass b-c walkable floor

The aim of the work carried out has been to develop BIPV solutions based on monocrystalline back contact cells to be applied on PV walkable floors and PV curtain walls.



MULTIFUNCTIONAL BIPV FAÇADE CLADDING SYSTEM WITH INTEGRATED INSULATION

PRODUCT

PRODUCT 3

DETAILS

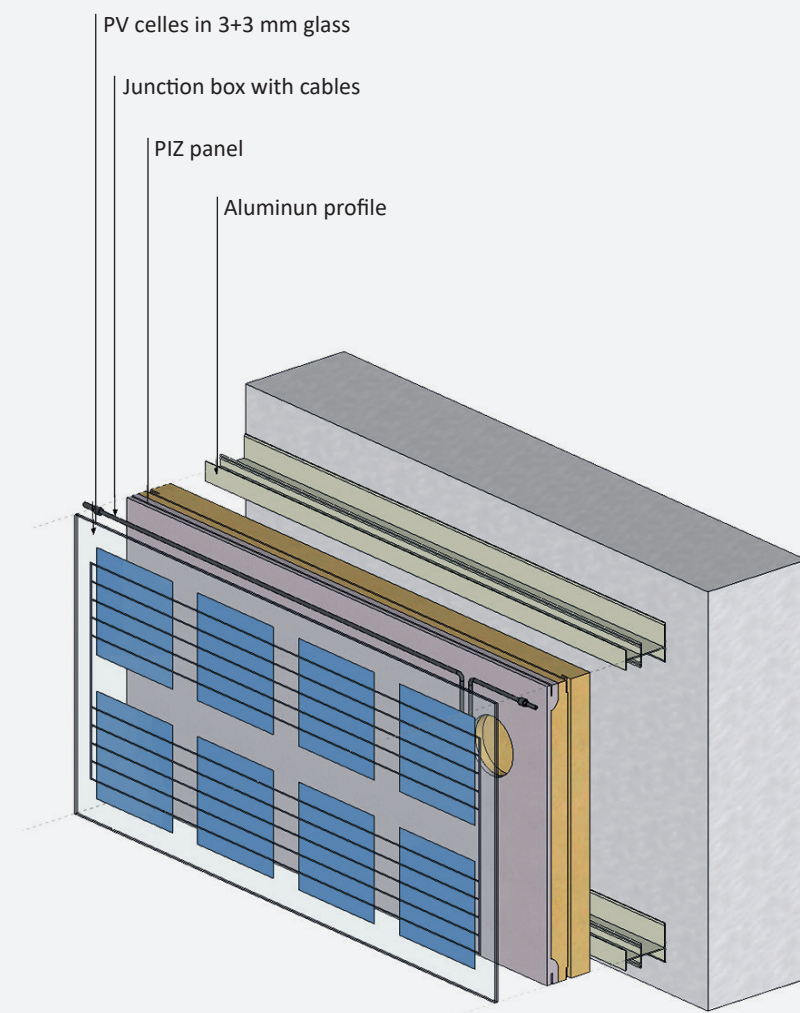
The BIPV façade cladding system developed under the BIPVBOOST project was named as ePIZ. It consists of a composite element, obtained by integrating PIZ cladding product with different photovoltaic (PV) technologies. The main concept of combining PIZ product with a PV element was to have a BIPV cladding system that can offer energy production, a high level of thermal insulation and a good level of acoustic insulation within one product along with an easy installation process.

The PIZ cladding product is CE certified and follows ETAG017. PIZ system is a breathable system with open joints so it has good water vapor permeability. It can be installed on the façade using a special aluminum mounting system. The lower and upper horizontal edges of the cement mortar are thickened and grooved to allow the insertion of continuous aluminum extruded rail. All the aluminum profiles are treated against atmospheric attack, the systems shall be secured to the existing sub-structure (iron frame, concrete wall, masonry wall) by means of screws or expansion fixings.

Different ways have been adopted for the product's realization:

- The 1st was using a glass-glass PV module produced by ONYX
- The 2nd was using a thin-film CIGS module produced by FLISOM

All modules were coupled with a panel produced by PIZ.



LOW COST CLICK&GO SUBSTRUCTURE FOR BIPV MODULES



PRODUCT 4

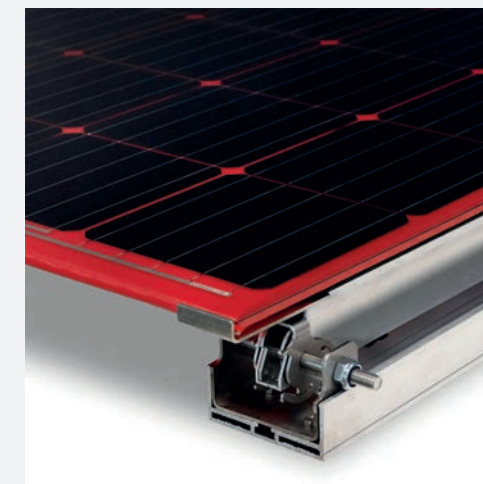
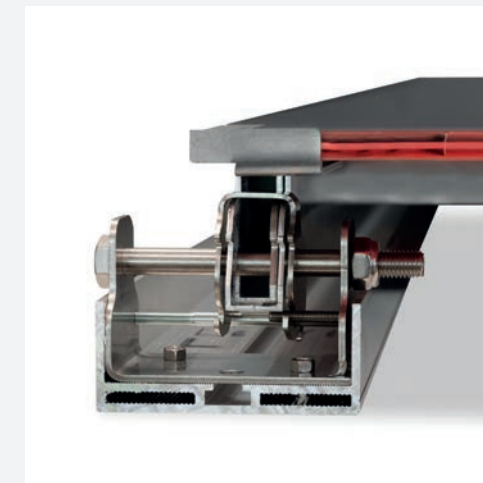
DETAILS

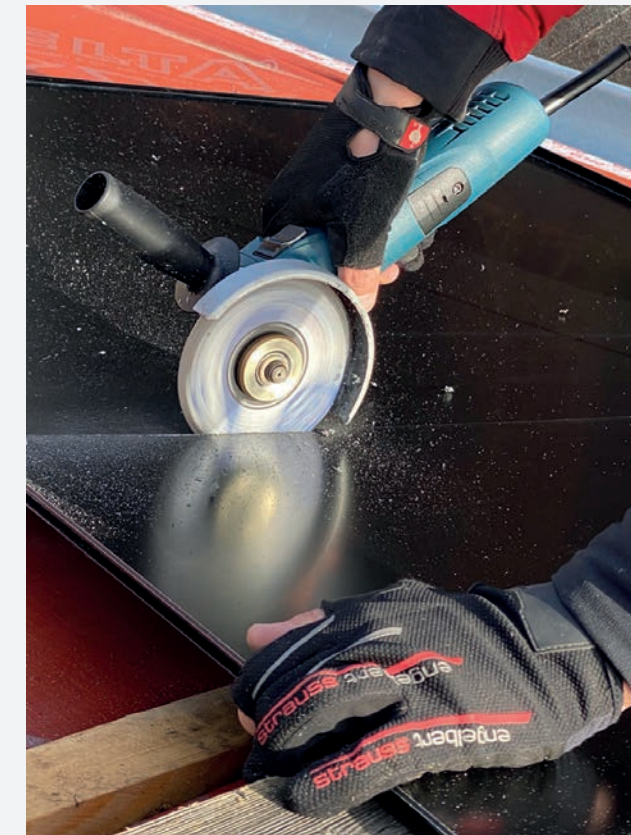
The innovative Click&Go mounting system enables ultra-fast, safe and low costs installation of a wide range of frameless PV modules sizes. The BIPV mounting system is completely invisible, and a special feature is that each PV module, after installation, can be easily individually removed for inspections and maintenance. The Click&Go mounting system is suitable to be used on any substructure. The Click&Go mounting system can be used for almost any glass-glass solar panel from various leading European manufacturers to provide freedom of choice to architects, facade builders and developing building companies. Design freedom for Click&Go BIPV facades is further enhanced by the possibility to combine solar panels with traditional (passive) facade panels on the same facade, for instance with ceramics tiles, composite materials, aluminium cassettes, aluminium composite cassettes, non-active tempered glass, wood, etc..

The Click&Go BIPV system, solar panels and mounting systems combined, is a proven technology that has been tested successfully at Dutch and at European knowledge institutes. The system is suitable for use on high-rise buildings up to 100 meters high. Building owners can generate 145 – 150 kWh per m² solar facade per year (in North Europe) and earn € 35 - 45 per m² per year and obtain a better energy label for the building.

The Click&Go mounting system can be easily designed by anyone using the BIPV.world platform. The BIPV.world platform is developed by TULiPPS to provide architects and facade builders with the right digital tools to design flawlessly. Designs made via the platform can be ordered and delivered to the construction site as a prefab system.

The SaaS platform provides direct insight into the costs and revenues of a BIPV application and will provide insight into the CO2 impact and the circularity of the designed systems.





ENHANCED, COST EFFECTIVE BIPV ROOF AND FACADES SYSTEMS FOR CIGS ON METAL



PRODUCT 5

DETAILS

BIPV roof systems are already widespread and available in a large number on the market. However, the hurdles on the way to a solar roof are manifold and, for stakeholders, dauntingly complex to overcome.

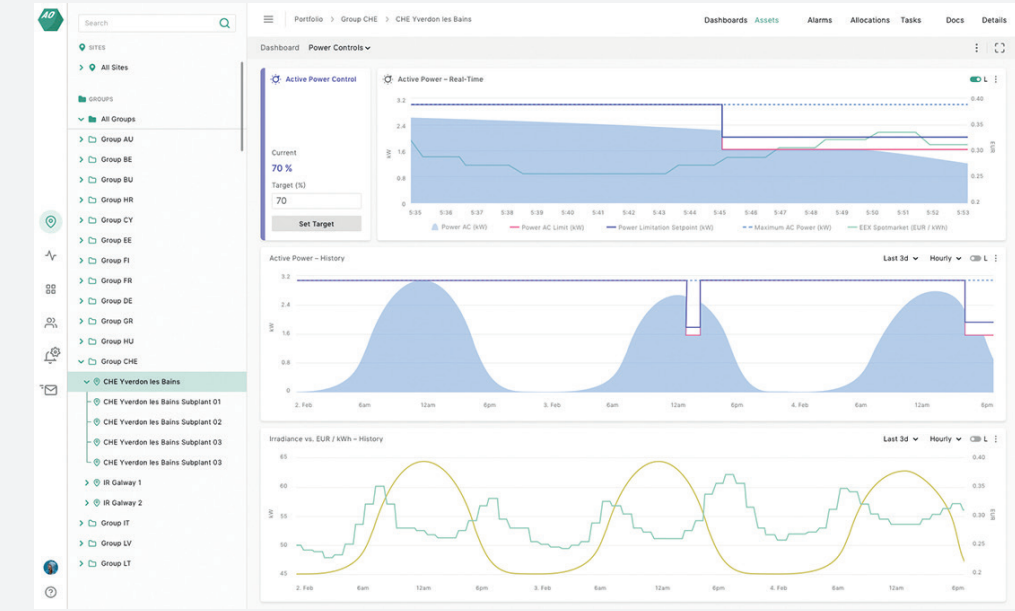
BIPVBOOST project analysed these hurdles along the entire value chain and specifically optimised for the involved stakeholders for the customer journey. For this purpose, a special website with the „Your road solar roof“ was set up and equipped with the relevant information (in German, French and English).

Planning documents: Exemplary are the technical drawings for structural connections to eaves, ridge, verge as well as skylights and chimneys. Furthermore, several leaflets on various specific planning topics have been newly created or revised. Checklists for planning and installation supplement the support for planners and installers.

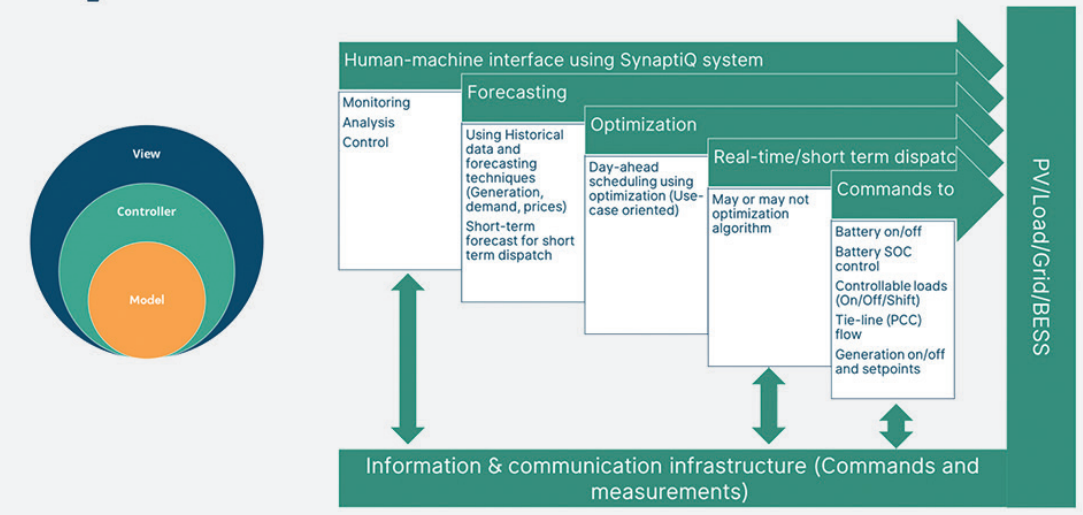
Consistent design tool: The BIPV roof system was integrated into a powerful planning tool. In addition to object registration, calculation of the solar yield, the software platform also enables all structural elements to be planned with wind and snow loads on a site- and object-specific basis and to generate parts lists. Planning with module families with different dimensions in width was developed especially for BIPV roof applications. In this way, existing roofs can be fully covered almost without additional inactive supplementary areas.

Product line extensions: For solar roof systems within existing tiled roofs (partial solar roofs), standardised flashing solutions for tiled roofing have been developed. This allows complex solar roof fields with recesses, etc. to be executed without on-site adaptations.

Installation: For installers, an installation tool has been developed that is available for the specific module size and allows the installation of the mounting brackets by an installer, which significantly reduces the installation effort.



Layered software architecture



CLOUD-BASED ENERGY MANAGEMENT SYSTEM FOR TERTIARY BUILDINGS, INCLUDING BIPV GENERATION AND STORAGE MANAGEMENT

SOFTWARE

PRODUCT 6

DETAILS

The BIPV Boost project has enriched SynaptiQ's Asset Flexibility module through the development of data intelligence and software modules that improve energy management of load, renewable energy and storage. Excess energy generation can be locally stored in a battery or building thermal inertia as the main sources of flexibility.

The developments include remote control functionalities and forecasting services that lead to optimizations in battery scheduling and thermal management, overall reducing the total energy costs. The distributed optimization provides a better energy saving than the Energy Management Systems operating isolated. By means of a collaborative model on a yearly load data, the average Self-Consumption and Self-Sufficiency Indices (SCI and SSI) are increased by 2.8 and 11.3 percent, respectively. The main results of the project are:

- Digital modelling of Battery Energy Storage System (BESS) in SynaptiQ
- 5-second real-time monitoring and control & remote manual/automatic scheduled control of each asset/ plant
- Open-API real-time monitoring and control interface for 3rd party application
- Certificate-based security enhancement
- An enhanced consumption forecasting (SVR, ARIMA)
- An enhanced PV production forecasting (grey-box modelling)
- A Simulation Tool for assessing the potential historical performance of the SynaptiQ flexibility management solution.
- Price-based cooperation with the thermal management system

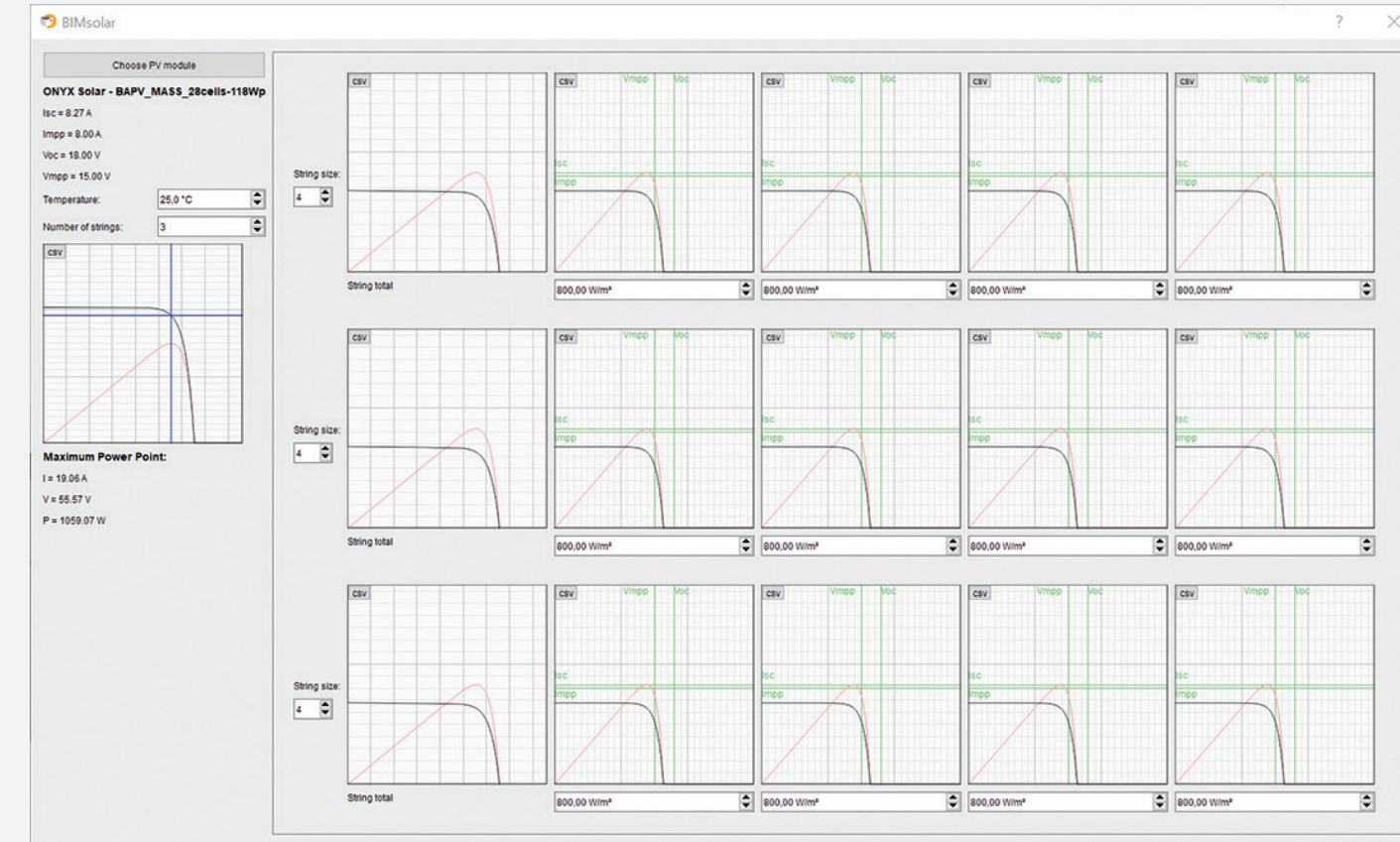
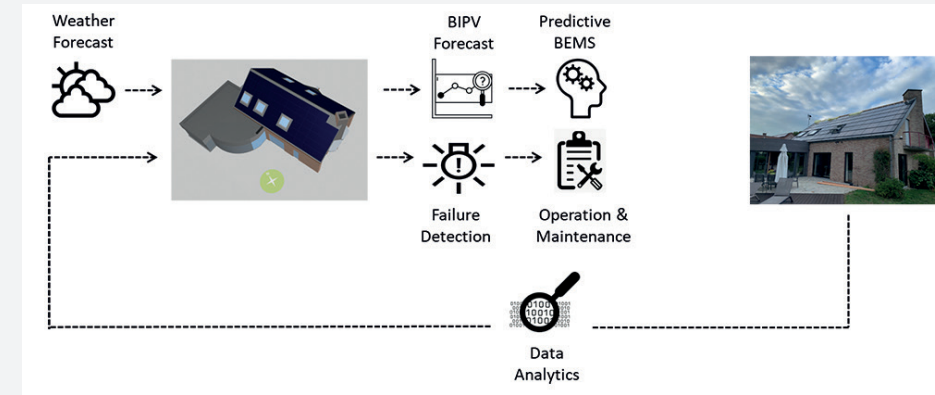
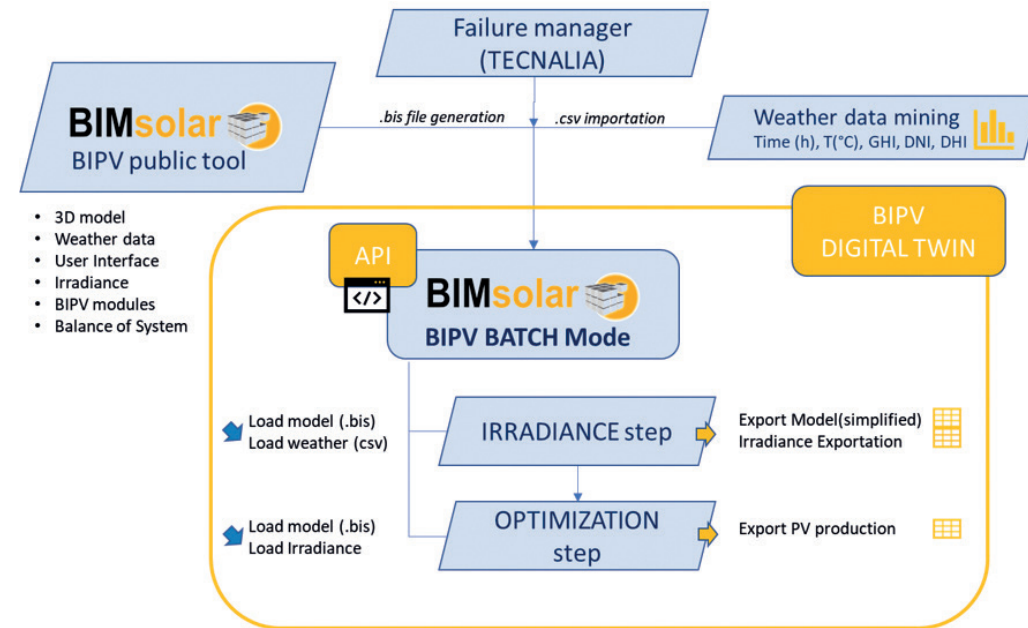
BIPV DIGITAL TWIN. FAILURE DETECTION AND DIAGNOSIS TOOL

SOFTWARE

DETAILS

The BIPV digital twin is based on BIMSOLAR®, a simulation software in 3D dedicated to solar architecture, that has been enriched with different techniques for the automatic calibration of its thermal and electrical models making use of monitoring data with the aim of characterizing and explaining the performance and state of health of the asset. This allows: (1) a precise early fault detection and diagnosis tool for a better operation and maintenance of a BIPV system and (2) a faster and further knowledge of the real performance and degradation processes of new emerging technologies in BIPV sector, that is crucial for optimization of future designs, as well as for reduction of uncertainties and risk investment.

PRODUCT 7



RESPONSIBLE PARTNERS

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MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE

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EnerBIM

AUGMENTED REALITY TO SUPPORT BIPV IMPLEMENTATION SINCE THE PRE-DESIGN STAGE

SOFTWARE

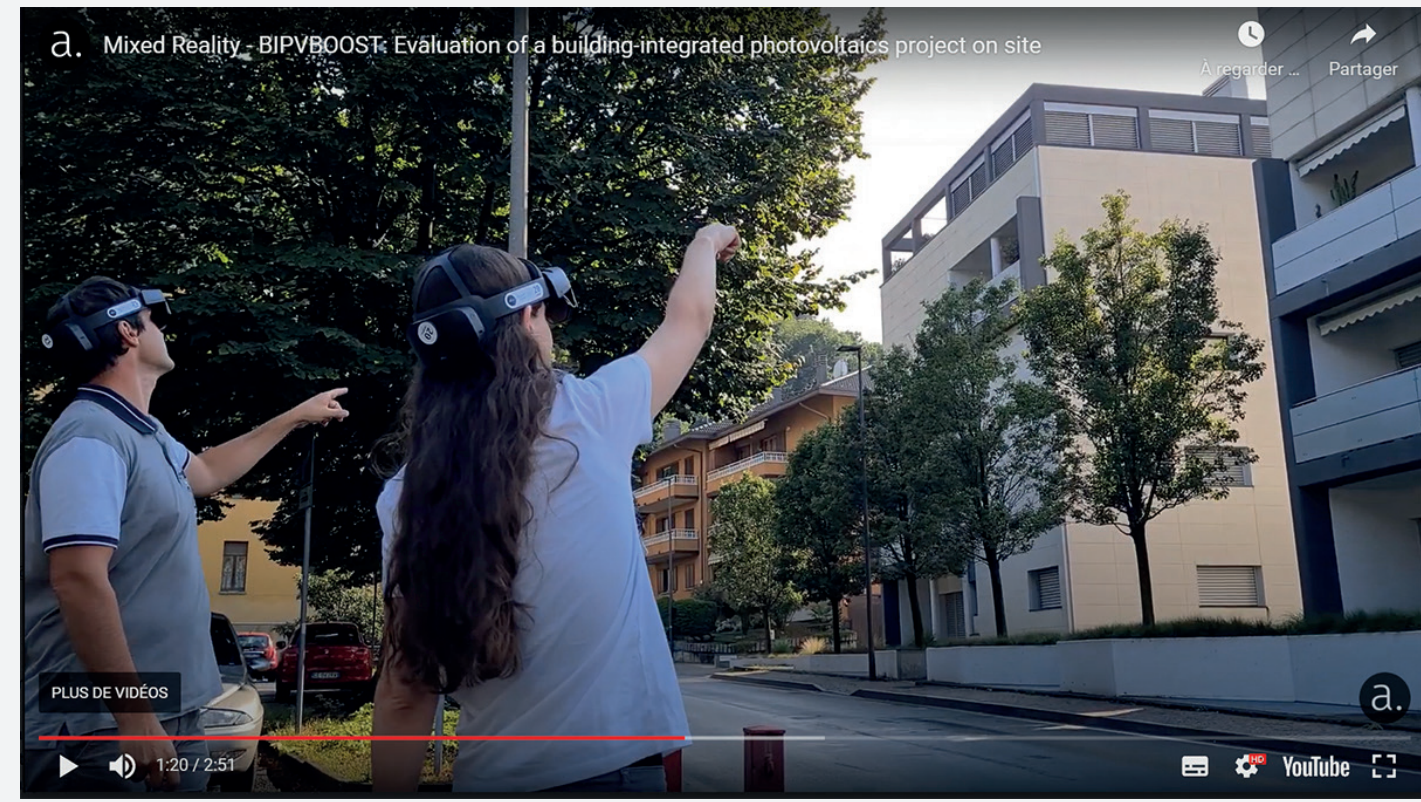
PRODUCT 8

DETAILS

SUPSI conducted a survey about the expected gains provided by virtual, augmented and mixed reality for BIPV professionals. The conclusions converge to a stronger support to anticipate building integration at earliest stages of the architectural design: aesthetical features must be associated to energy production and customisable options for BIPV materials, then probable cost and CHG emissions should be rated.

A successful proof of concept was conducted on the real PIZ buildings in Morbegno (IT), with the commitment of experts: SUPSI (BIPV knowledge management), EnerBIM (3D design and simulation with BIMsolar), and AFCA (MS HoloLens technology and MR science).

The proof of concept of MR for BIPV was developed to help BIPV architects and engineers to make their BIPV projects more understandable by clients and investors that can interact with a virtual BIPV building integrated into the actual context.



<https://www.youtube.com/watch?v=PsvnvNacpTc>

BIM-BASED SOFTWARE TOOL SUPPORTING THE BIPV PROCESS DESIGN, MANUFACTURING, INSTALLATION, OPERATION AND MAINTENANCE

DETAILS

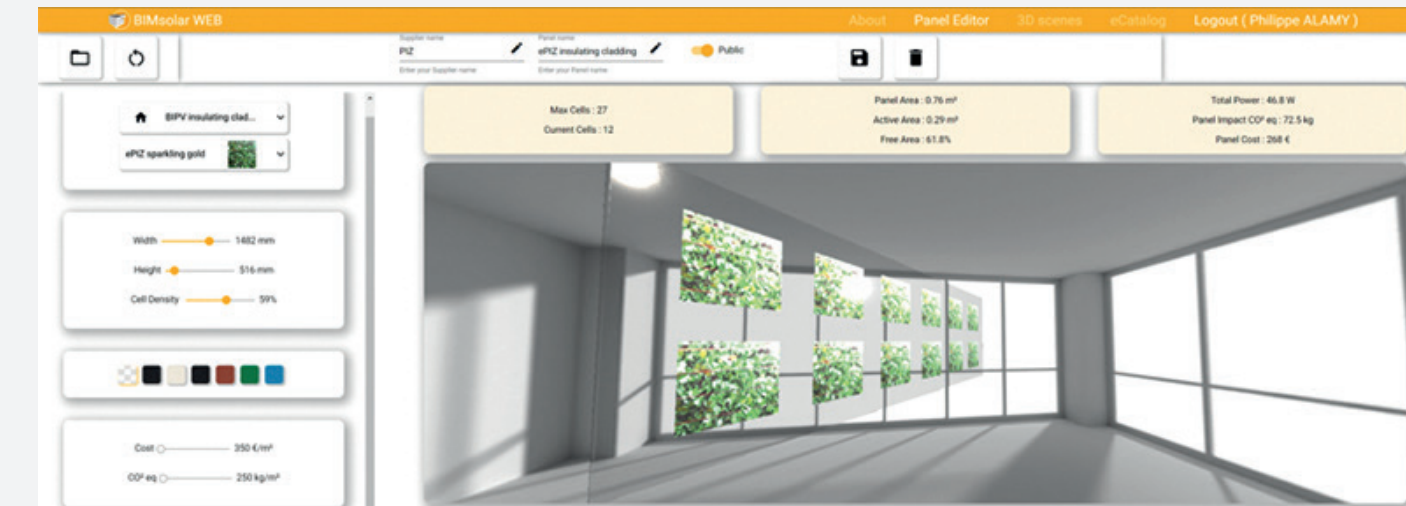
From BIPV modules pre-design online to comprehensive BIPV layouts design and performance simulation, BIMsolar from ENERBIM is developed to fulfil the BIPV value chain.

BIM (Building Information Modeling) is an essential market driver for BIPV inclusion into the AEC (architecture, Engineering and Construction) workflows.

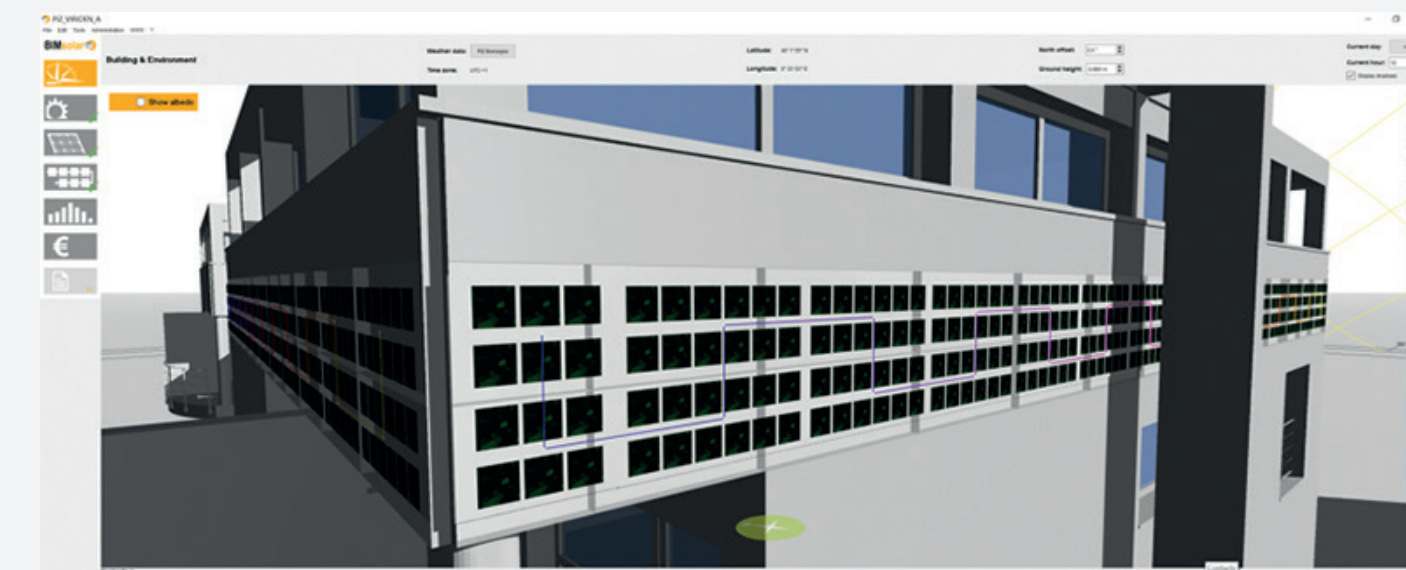
The BIMsolar solution is a set of connected software services that manages crucial information from pre-design to operation and maintenance, including expert third-parties modules (EDGE-HP from EURAC and XTREME from OPTIMAL), connecting to manufacturing tools and optimization algorithms.

BIPV experts can address AEC professionals with seamless access to 3D workspaces and contextual KPIs.

Full web BIMsolar Product Information Manager



BIMsolar unique BIPV & BIM software



INDOOR & OUTDOOR PERFORMANCE-BASED LABORATORY TESTING PROCEDURES FOR BIPV PRODUCTS

SERVICE

PRODUCT 10

DETAILS

BIPVBOOST provided the overview of the current normative framework in BIPV field, the definition of the relevant missing gaps, and the key-aspects for grounding a new testing approach. In order to overcome some of these barriers and challenges, the project progressed with newly developed procedures for the qualification of some BIPV product requirements, with the ambition to address a more complete qualification scheme and favour the product introduction into market.

- The main technical challenges to unlock Building Integrated Photovoltaics (BIPV); massive potential and installation capacity are today mostly related to cost-effectiveness and product quality.
- Integrating PV in construction products, requires an accurate performance assessment in accordance with construction norms and PV standards, depending on the type of use in building.
- Although the EN 50583 introduced a reference framework in Europe, BIPV multifunctional products are currently stagnant in uncertain qualification processes with the lack of clear regulations and missing gaps in normative that could facilitate its diffusion and acceptance.

The project focused, and established new test performance assessment procedures, on the following:

- Energy Economy
- Mechanical Safety
- Electrical Safety
- Fire Safety



RESPONSIBLE PARTNERS

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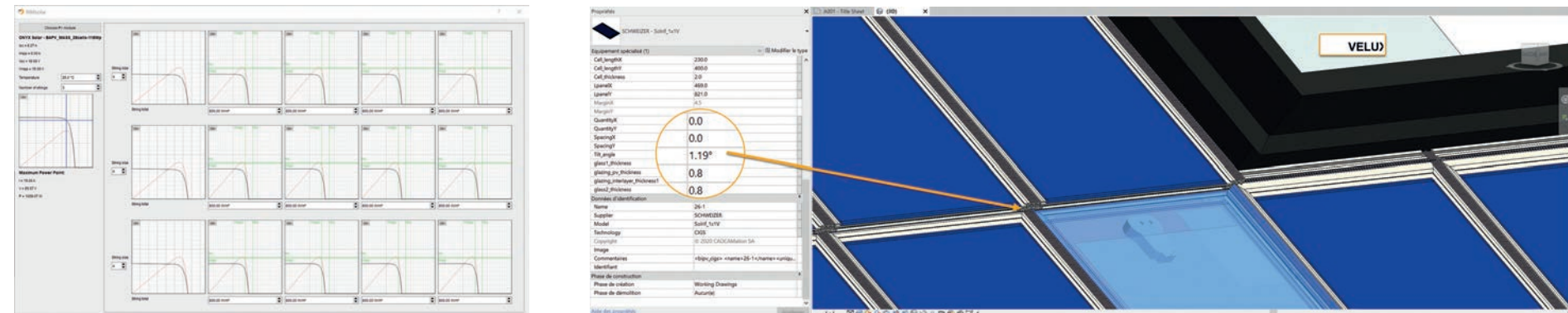
TECNALIA

DIGITAL ADOPTION PLAN AND GUIDELINE FOR A DATA-DRIVEN BIPV PROCESS

DETAILS

Public Deliverable D6.1 and related studies provide a clear vision and understanding of the BIPV development process, by presenting a reference one, including involved stakeholders, their roles and current practices. This comprehensive analysis gives an overview of how it could be adapted to be more efficient, through the increased use and share of data, with BIM innovations. Best practices and recommendations, in the form of a digital adoption plan, is delivered.

The outcome is available for the whole BIPV and construction community as conclusions will eventually be an open source.



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