

# BIPV4ALL

BIPV4ALL advances digitalization and automation to truly make BIPV affordable for all

## SETTING THE SCENE

As part of the EU Green Deal, the EU Commission has set ambitious targets to improve buildings' energy performance, including promoting energy efficient investments in buildings. Building-Integrated Photovoltaics (BIPV) will be part of the solution: BIPV elements produce electricity and additionally offer at least insulation against heat and cold, and protection against moisture. To help enable the mass realization of Nearly Zero Energy Buildings, the use of such elements should become mainstream in the coming years.

Despite the vast potential of BIPV, the current solutions still face significant challenges.

The fragmented workflow between architecture, engineering, and construction hampers efficiency, leading to high design costs and delays. Additionally, current BIPV solutions lack flexibility and modularity, limiting their scalability. Issues such as the mismatch between BIPV aesthetics and traditional building elements, along with the manual production processes, further increase costs and impede a broader adoption.

To overcome these limitations, the BIPV4ALL project seeks to streamline the design process and enhance both the performance and aesthetics of BIPV technologies, enabling a more widespread adoption across the construction industry.

## FRAMING THE RESEARCH OBJECTIVE

The objective of the BIPV4ALL project was to develop integrated digital workflows and innovative technologies that address the limitations of current BIPV solutions.

The project aimed to create more efficient manufacturing processes, improve the aesthetics of BIPV modules, and improve

the performance through advanced glass coloring techniques and automated production methods. At the same time, it has also investigated the possibilities for improving the shade tolerance of such BIPV modules, i.e., limiting the impact of partial shading on its potential to generate power.

## THREE MAIN OUTCOMES

The BIPV4ALL project has yielded three key outcomes, each contributing significantly to advancing BIPV.

First, the project developed a **digital integrated workflow** that simplifies the entire BIPV design and manufacturing process. This workflow connects different construction phases and stakeholders, including architects, engineers, and manufacturers, ensuring better communication and efficiency. The platform includes tools for **energy yield simulation** and **automated generation of technical drawings**, helping optimize energy performance and ease the manufacturing of custom BIPV products. This innovation reduces the costs and improves the feasibility of BIPV projects, addressing a major limitation of current fragmented processes.

Secondly, the project has introduced two new technologies: **novel glass-coloring technologies** that address the aesthetic limitations of current BIPV systems, and an innovative concept for integrating local bypass diodes and parallel connections that allow an increased performance in conditions of partial shading. By improving both appearance and functionality, these solutions position BIPV as a more viable option for mainstream building applications.

Thirdly, the partners have developed **automated bussing tools** that significantly improve the production process for BIPV

modules. These flexible tools eliminate the need for manual soldering, reducing production time and costs while enhancing reliability. The automation is compatible with a wide range of BIPV module designs, including those that use advanced cell interconnection technologies. This development addresses the current challenge of high labor costs and operator-dependent quality in BIPV manufacturing, enabling greater scalability.

Compared to commercial solutions, BIPV4ALL's approach offers significant improvements. The **integrated workflow** reduces **design and assembly costs** by up to 10% by improving interoperability and reducing errors across construction phases. The new glass-coloring techniques provide **superior visual and functional performance**, making BIPV elements indistinguishable from traditional building components. Additionally, the **automated bussing technologies** lower production costs by minimizing manual labor and improving the reliability of BIPV modules. These advancements make BIPV systems not only more affordable but also more attractive to architects and building owners, paving the way for a broader adoption.

## NEXT STEPS

With the results of BIPV4ALL, the project partners will start commercializing the developed technologies, particularly the glass-coloring solutions and automated bussing tools, which are expected to enter the market to enhance BIPV product offerings. Additionally, the digital workflow platform will be refined for broader industry use.

The partners will continue to explore new applications for BIPV in both residential and commercial building markets. They plan follow-up research to further improve their innovations, focusing on optimizing energy yield simulations and exploring a novel technical weave concept, integrating bypass diodes for better shading tolerance, durability, and safety.

A14FoodLogistics project partners:



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## FACTS

NAME	BIPV4ALL
OBJECTIVE	Streamline BIPV design and manufacturing with cost-effective solutions
TECHNOLOGIES USED	BIPV digital workflow, glass-coloring solutions, automated bussing tools, energy yield simulation, technical weave with bypass diodes, shade-tolerant module designs.
TYPE	imec.icon project
DURATION	01/10/2020 – 30/09/2024
PROJECT LEAD	Stefan Dewallef, Soltech
RESEARCH LEAD	Tom Borgers, imec - PVMS
BUDGET	2.477.777 euro
PROJECT PARTNERS	IPTA Factory Automation, VdS Weaving, Soltech NV, AGC Mirodan Bouwglass, VK Engineering
RESEARCH GROUPS	imec – Energy Systems, imec – WAFERPV



## WHAT IS AN IMEC.ICON PROJECT?

The imec.icon research program equals demand-driven, cooperative research. The driving force behind imec.icon projects are multidisciplinary teams of imec researchers, industry partners and/or social-profit organizations. Together, they lay the foundation of digital solutions which find their way into the product portfolios of the participating partners.

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