



SUPSI

Research for BIPV in Switzerland

A collaboration model between applied research and industry

«BIPV beyond Task 15»

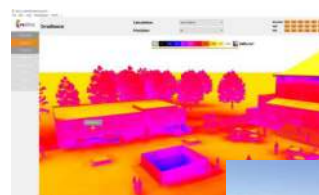
Perspectives from politics, finance and building owners

Dr. Pierluigi Bonomo

Head of BIPV Innovative Building Skin team

SUPSI-ISAAC

29 novembre 2021



SUPSI

Mini conference «BIPV beyond Task 15»

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SUPSI and PV, a journey since 1982

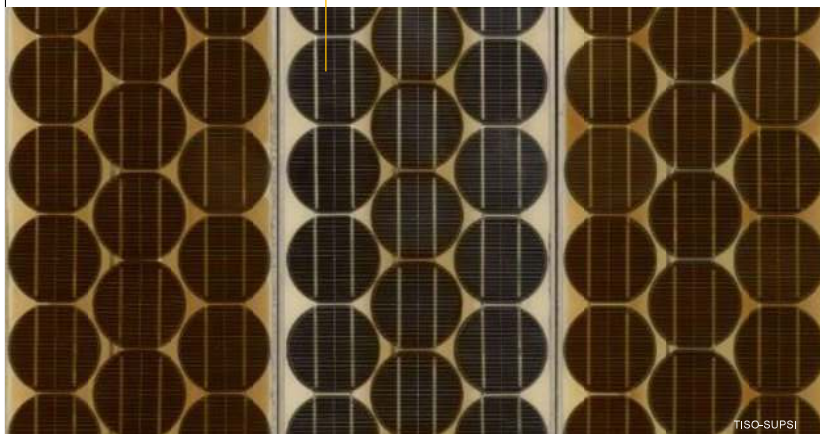
TISO

BIPV

1982

2003

2021



TISO-SUPSI



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Research at SUPSI: a practice-oriented model in building & architecture

- UAS: studies focus on the requirements of professional life
- Practice-oriented (innovation>market>business)
- Direct relation with professionals and industry
- Local, national and international networking



PV&architecture matching, SUPSI and BIPV towards 20 years

- **Multidisciplinary team:** architects, engineers, physicists, technicians
- Building Sector and PVLab as a «macro-team»
- **Applied-oriented research:** with industries, architects and building owners for **market transfer (TRL4 >TRL8)**
- **Market/business oriented innovation** → spin-off

PV integration

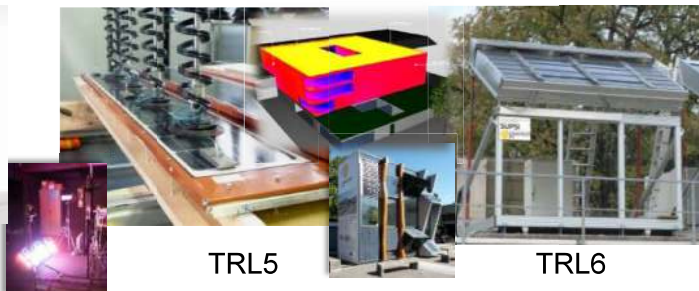
Test & Qualification

Demonstration & pilots

Market impact



TRL4



TRL5

TRL6



TRL7/8

www.solarchitecture.ch



Research on BIPV: “impact-oriented” approach

Product

Optimization, validation,
and performance

Process

BIPV simulation and BIM
Cost-competitiveness

Knowledge

BIPV and retrofitting
BIPV and architecture

R&D of building skin systems with **industry**

New performance-based testing

Pilot buildings consult./monitoring

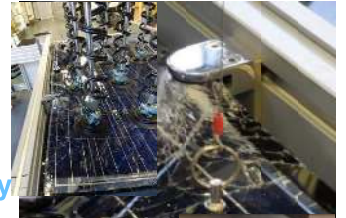
Cost-assessment of real cases

Digital platforms for BIPV design

BIPV in sensitive contexts

Solar Architecture platform
(www.solarchitecture.ch)

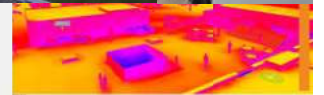
Industry
Manufacturers
Installers



Owners
Municipality



Architects
Authorities



KEY-TOPICS

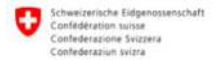
ACTIVITIES

PLAYERS

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SOLARCHITECTURE
sun as a building material



Product

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BIPV Architecture

- ***“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



Swiss BIPV technology and industry

Many examples of collaboration of research and industry:

- Aesthetics is the product driver (architectural quality is a “must”)
- Multifunctional products (PV is part of building skin system)
- Standard and customization (mass-production and tailor-made)



(source: Faceactive-Balneg)



Coloured modules (photo: P. Bonomo)



Megaslate (3S)



(source: Kaleo Solar)



White PV (source: Solaxess)



Marble effect (source: Sunage SUNCOL)



(source: Schweizer)

BIPVBOOST Horizon 2020 project (2018-2023)

Bringing down costs of building-integrated photovoltaic (BIPV) solutions and processes along the value chain

Challenge:

BIPV market hindered by some key demands from the market:

- Aesthetics
- Flexibility of design
- Cost-effectiveness

Cost reduction strategies:

1. Flexible and automated BIPV manufacturing process
2. Large portfolio of multifunctional BIPV products
3. Digitalized process along the value chain
4. Advanced standardization activities supporting the qualification of BIPV systems for a massive implementation in the building skin

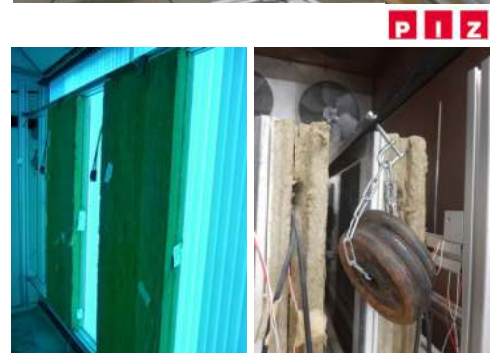


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Quality of multifunctional BIPV roof and facade cladding systems



- Multifunctional component engineering
- Construction and electrical optimization (TRL4)
- Indoor PV and building-related quality/safety testing (TRL5)
- Outdoor real-scale demonstration and validation (TRL6)
- Demonstration in real environment (TRL7)



Innovation to support BIPV testing

Approach: performance-based and limit-states > engineering approach, cost-reduction

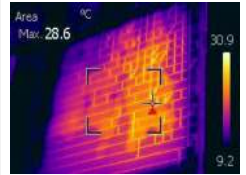
Methodology:

- Analysis of relevant building and PV standards
- Determination of missing, redundant or incomplete requirements for BIPV
- Decision on the need of add/improve a BIPV requirement
- *Feedback* from industries and arch./engineers
- Development of new test procedures



Key-requirements

- Energy economy (EE)
- Electrical safety in non-conventional scenarios
- Mechanical safety and performance
- Fire reaction of BIPV components/systems



source: SUPSI

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BIPV
boost

Process

BIPV Pilot&Demo projects, as interface between research and market

- Interaction with different **stakeholder levels**:
 - Owner
 - Architect
 - DSO
 - BIPV manufacturer, installer
- Transfer/test technology
- System integration, economic viability and marketability



BIPVBOOST demo in Morbegno



POLIS public building in Lugano



Pilot+Domo project in Lugano (FUS)

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P&D: PV Dynamic Solar Shading System for transparent facades

- Demonstrate the market for **highly aesthetic and prefab BIPV dynamic shading** to facilitate technical & economic benefits

Some goals:

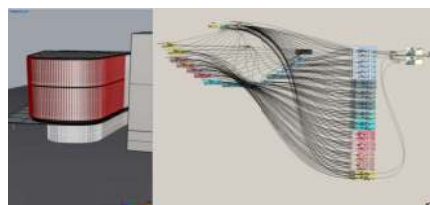
- Reliability and efficiency for transparent façade
- Impact of prefab on installation, dismantling and final user cost.
- System cost reduction

Partners:


Scuola universitaria professionale
della Svizzera italiana

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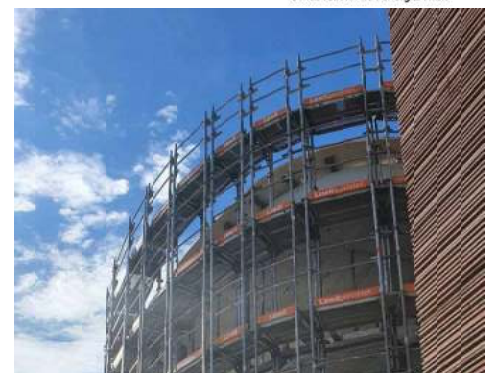
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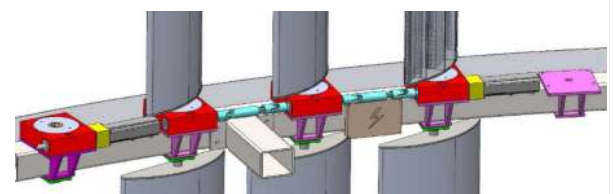
Simulation of the dynamic system (SUPSI)

 Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Bundesamt für Energie BFE
Office fédéral de l'énergie OFEN



Status of the construction site 18.10.2021. Source: SUPSI

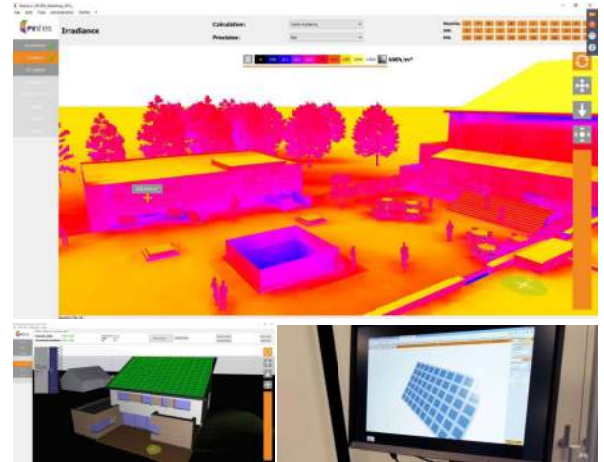


Back view of the louvers and the handling system. Source: Kummeler-Matters SA & Poretti-Gaggini SA

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BIPV and digitization of the process -1

- Digitize the process for supporting a more **efficient information management along the value-chain**
- Support development of software platforms for BIPV design and simulation
- Favor interoperability with AEC process
- Developing and validating simulation models for BIPV



Source: PVSITES (www.pvsites.eu), ConstructPV (www.constructpv.eu)

In partnership with:



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Bonomo, Pierluigi and Saretta, Enka and Frontini, Francesco (2018) Towards the implementation of a BIM-based approach in BIPV sector: CONFERENCE ON ADVANCED BUILDING SKINS 2018

BIPV and digitization of the process -2

- Support decision making stage (pre-design, conceptual stage)
- Investigation of Augmented, Virtual or Mixed Reality for pre-design to support BIPV cost-reduction, and development of first proof of concept.



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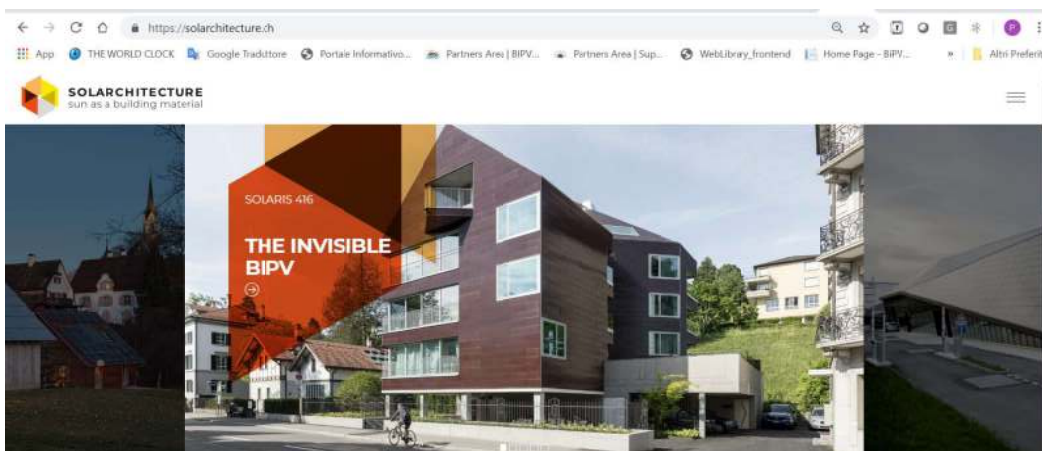


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Knowledge

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«sun as a building material»: www.solararchitecture.ch



SCAN ME



Key figures (2020-21):

- 19,500 users
- World Wide users
- **7,424 from Switzerland**
- 5min avg session duration



SUPSI **ETH** zürich SWISSOLAR

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«sun as a building material»: www.solarchitecture.ch



SOLAR POWER OFFENSIVE IN THE CITY OF ZURICH

The city of Zurich aims to produce four times as much solar power by 2030, and five times as much on municipal buildings. With a...



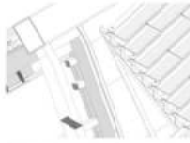
TWO HOUSES IN CHIGNY

The project follows the prevailing characteristics of this rural site, where solitary volumes in conglomerates provide space and shelter for everyday activities. By adding a house and following the typology...



FEHLMANN HOUSING DEVELOPMENT

In 2010, BCP realized six residential buildings on the Fehlmann area in Winterthur. From August 2020, two new buildings complete the development of the area, tying in...



DETAILS TWO HOUSES IN CHIGNY

The building, the roof, the facade as well as the technology, merge into a distinctive multifunctional architectural solar envelope. Amidst the externally visible and supporting...



IN A NUTSHELL - TICON EIENDOM IN DRAMMEN

The photovoltaic modules were required to be the same color as the cladding panels before renovation. They were used as PV 'spancels' on the south, east and west facades.



PROJECT BY VIRIDÉN + PARTNER AG IN SEEWÄDELSTRASSE

The new replacement building, centrally located in Affoltern am Albis, is a compact three-storey residential building with a top floor that...



RENÉ SCHMID ARCHITEKTEN AG, PROJECT IN MÄNNEDORF

The residential development is the second flagship project of the Umwelt Arena Foundation Switzerland and René Schmid Architects AG in...



URBAN BIPV RETROFIT POTENTIAL OF FACADES

When renovating existing buildings, the energy retrofit of building envelopes is often implemented. Typically, this intervention is considered by building owners...



DESIGN AS A BOOST FOR RENEWABLE ENERGY

Solar cells as design objects now adorn the facade above the main entrance to the NEST building of Empa and Eawag. The design is the result of an interdisciplinary...



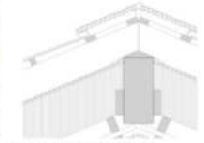
IN A NUTSHELL - SONNENKRAFT SOLAR SHED ROOF

Sonnenkraft builds a giant shed roof at its own site in Austria. The storage area is made entirely of wood and is covered with 800 bifacial modules.



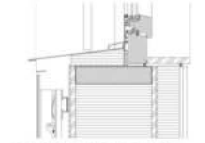
SOLAR BUILDING EXCURSION 2021

This year's solar building excursion will take its participants to the canton of Ticino, from Cugnascio to Lugano, Chiasso, Vecello and Mendrisio. The group will visit various...



DETAILS BRUNNER-BAPST HOUSE

The wooden gable roof construction of this new building is covered by a PV installation over its entire surface. Between the copper ridge and eaves details, the homogeneously black...



DETAILS PROJECT BY VIRIDÉN + PARTNER AG IN SEEWÄDELSTRASSE

The building is a hybrid construction. This means that the load-bearing walls, the intermediate slabs and the staircase core are made of...



3RD SYMPOSIUM SOLAR ARCHITECTURE

This year's symposium will demonstrate the application of solar architecture not only on the basis of individual projects, but also in relation to urban and site planning...

DETAILS BUILDING HÖR

Already defined building areas. T...

IN A KIND EINC

Shining space in elegant powere...

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Supporting partners:



Synage SA
Design, development and production of photovoltaic modules



3S Solar plus AG
We manufacture solar modules with 3S technology



Kito Solar
Together we will change the future with solar energy



Kromatix
The elegant BIPV solution for residential buildings



Energy solutions from ewz
The energy company for the canton of Zurich



SEEN AG
Smart solutions for your architecture

BIPV Status Report 2020

1. Evolution of BIPV in 40 years: architecture, technology & costs
2. BIPV **products and market** overview
3. Competitiveness and **cost-effectiveness of BIPV** in Europe

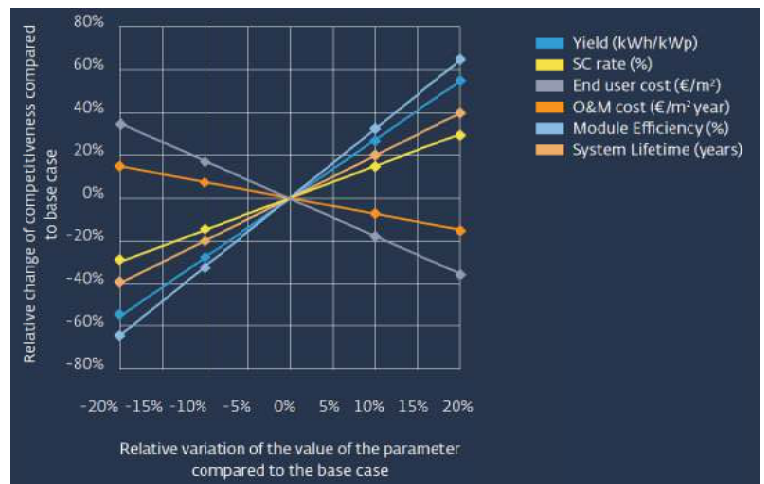
Focus on real case studies

4. Residential and administrative building, Lugano
5. Multifamily house, Zurich
6. Single family house, Knivsta

In collaboration with:



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Relative variation of the value of the parameter compared to the base case

Available at:

https://solarchitecture.ch/wp-content/uploads/2020/11/201022_BIPV_web_V01.pdf

Outlook

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Conclusion: most significant dynamics in recent years

Focusing the approach

- From service orientation to **competitive R&D on applied research**
- Strong focus on **prototyping, pilots and demo** with industries
- **Research towards market**: technical and economic analysis

Embracing new challenges

- **Glocal**: the strength of local and global together
- Quality, beyond sectors and disciplines: **collaboration AEC&PV**
- Inspiration for professionals: **communication!**

Looking beyond the borders...

- Spin-off: iWin – innovative Windows



Thanks for your attention



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