

# World's first automated R2R Manufacturing Line for Integrated Organic Photovoltaics

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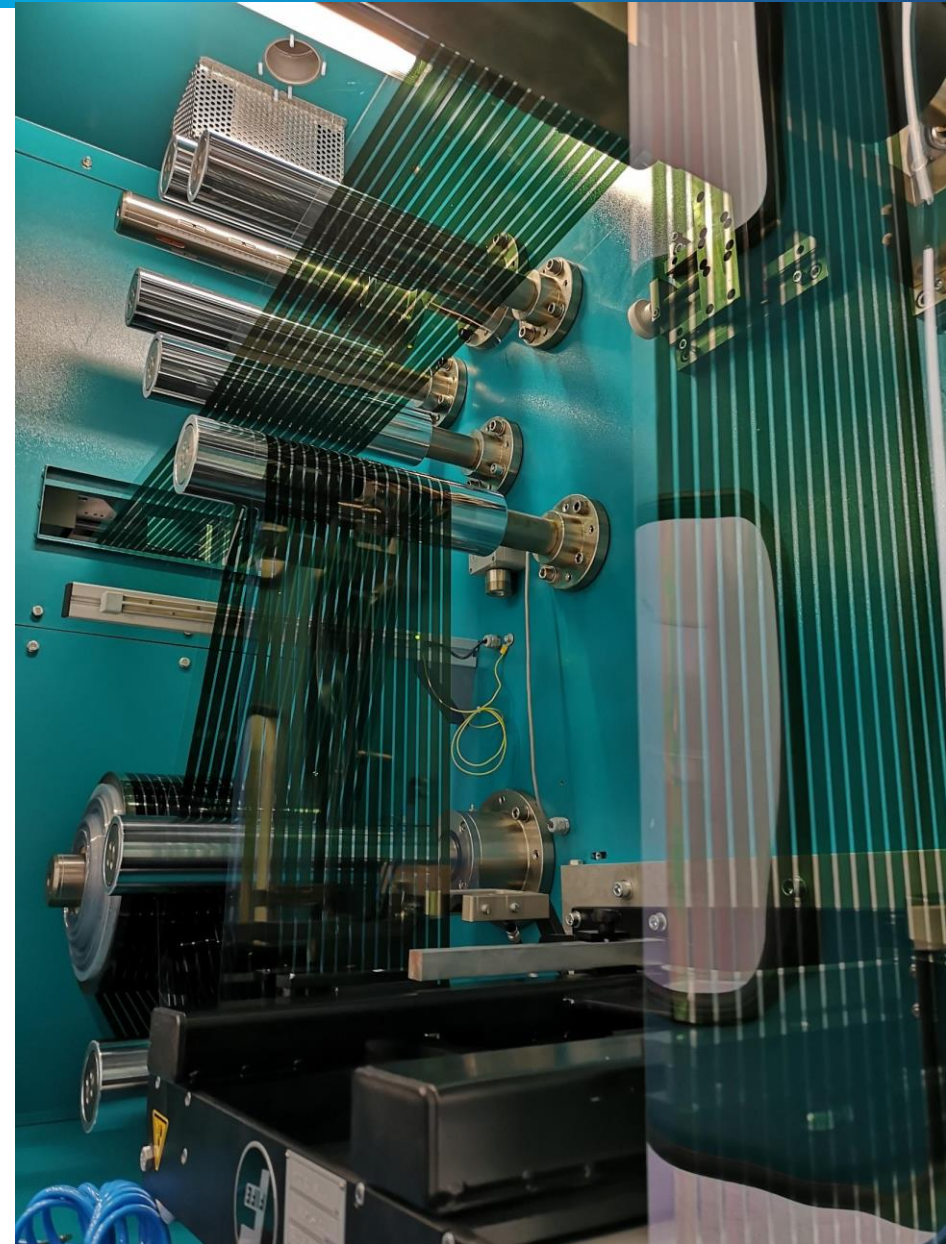
[flex2energy.eu](http://flex2energy.eu)

This project has received funding from the European Union's HORIZON Europe research and innovation programme under Grant Agreement No 101096803



# Outline

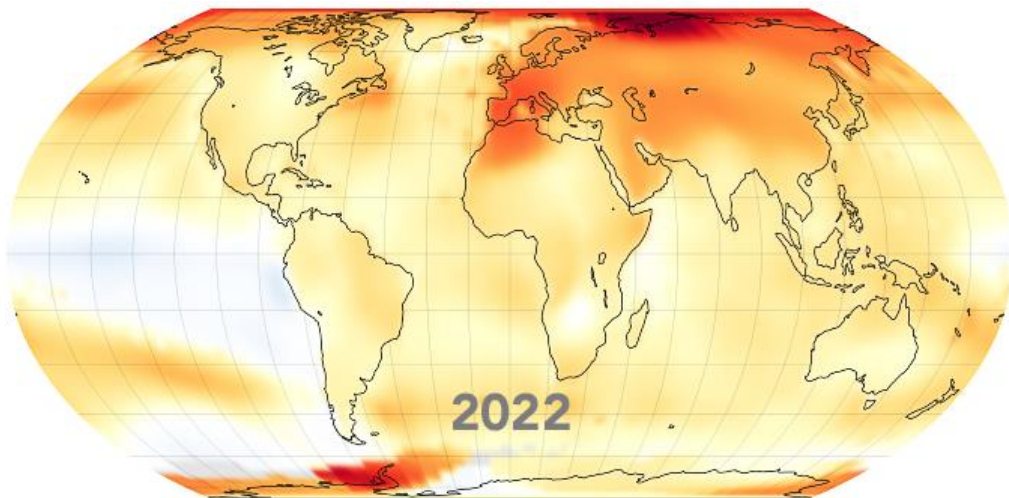
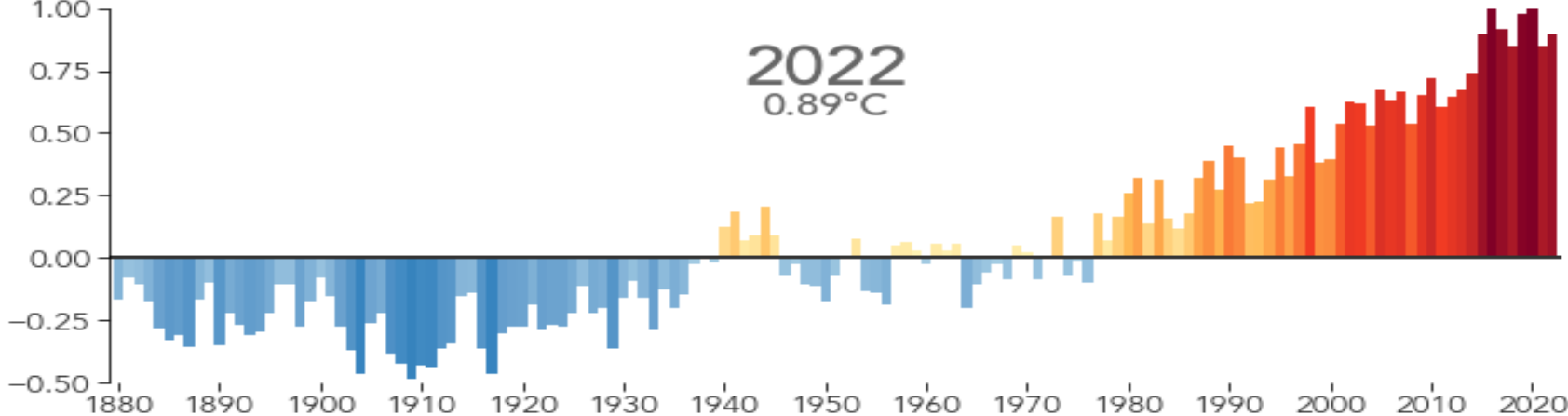
- **Global Challenges, Drivers, Opportunities**
- **Organic PVs and the Story Behind**
- **F2E Automated Manufacturing Production Line**
- **Integrated OPV Products towards Energy Positive Buildings**



# Our Planet is heating fast

## Last 9 Years Warmest on Record

Global Temperature Anomaly (°C compared to the 1951-1980 average)



Temperature Anomaly (°C compared to the 1951-1980 average)



<https://earthobservatory.nasa.gov>

# Designing a set of deeply transformative policies

**Green Deal:** Zero Net Emissions of Greenhouse Gases by 2050, by Boosting the **Efficient use of Resources**, by Moving to a Clean, Digital and Circular economy.



# Renovation Wave

**By 2030, the EU should reduce Buildings' GHG emissions by 60%**

**Buildings** are responsible for **40%** of the EU's total Energy consumption & **36%** of its **GHG emissions**

New Buildings today consume **50% of the Energy** to similar buildings **20 years ago**

**71%** of all Energy is used only for **space heating**



**35%** of the Building stock is over **50 years old**

Up to **97%** of Buildings need **Partial or Deep renovation** to comply with the long-term strategy ambition

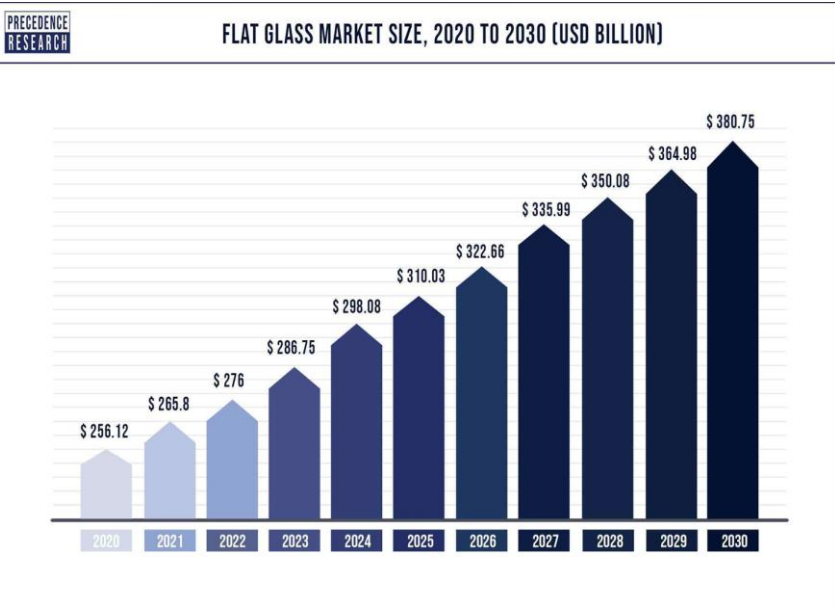
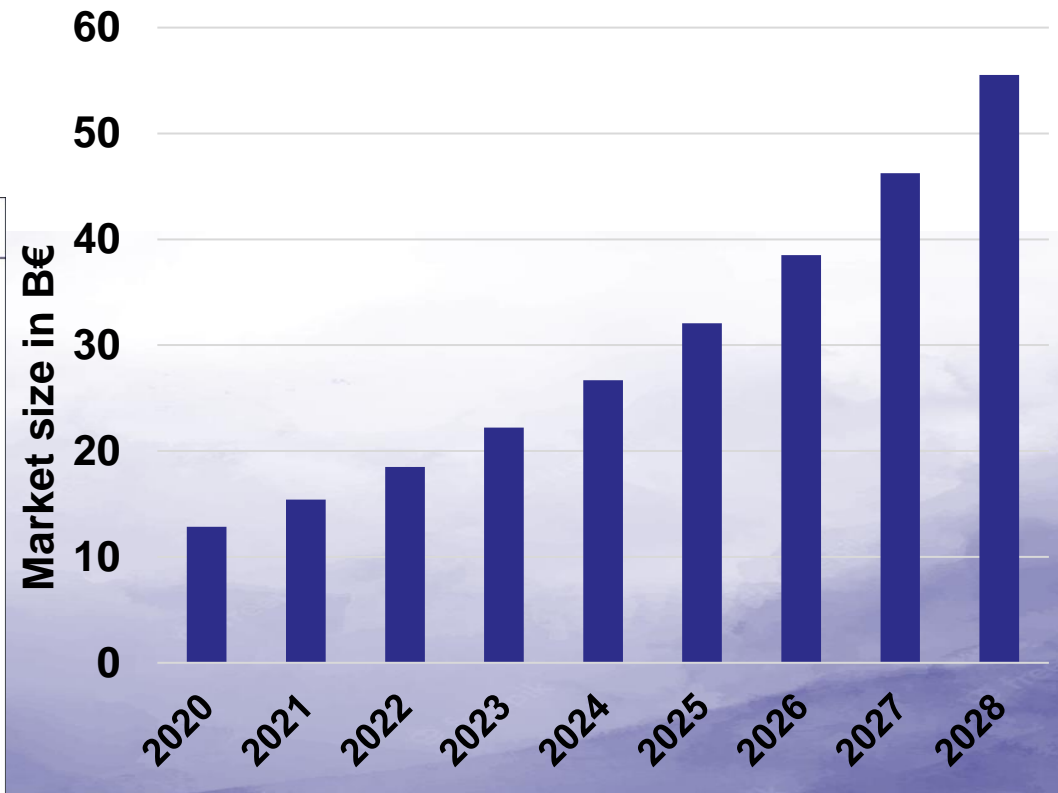
Source: impactlab

# Global BIPV Market, mostly on facades

**55,5 B€**  
by 2028  
with a CAGR  
**20,1%**



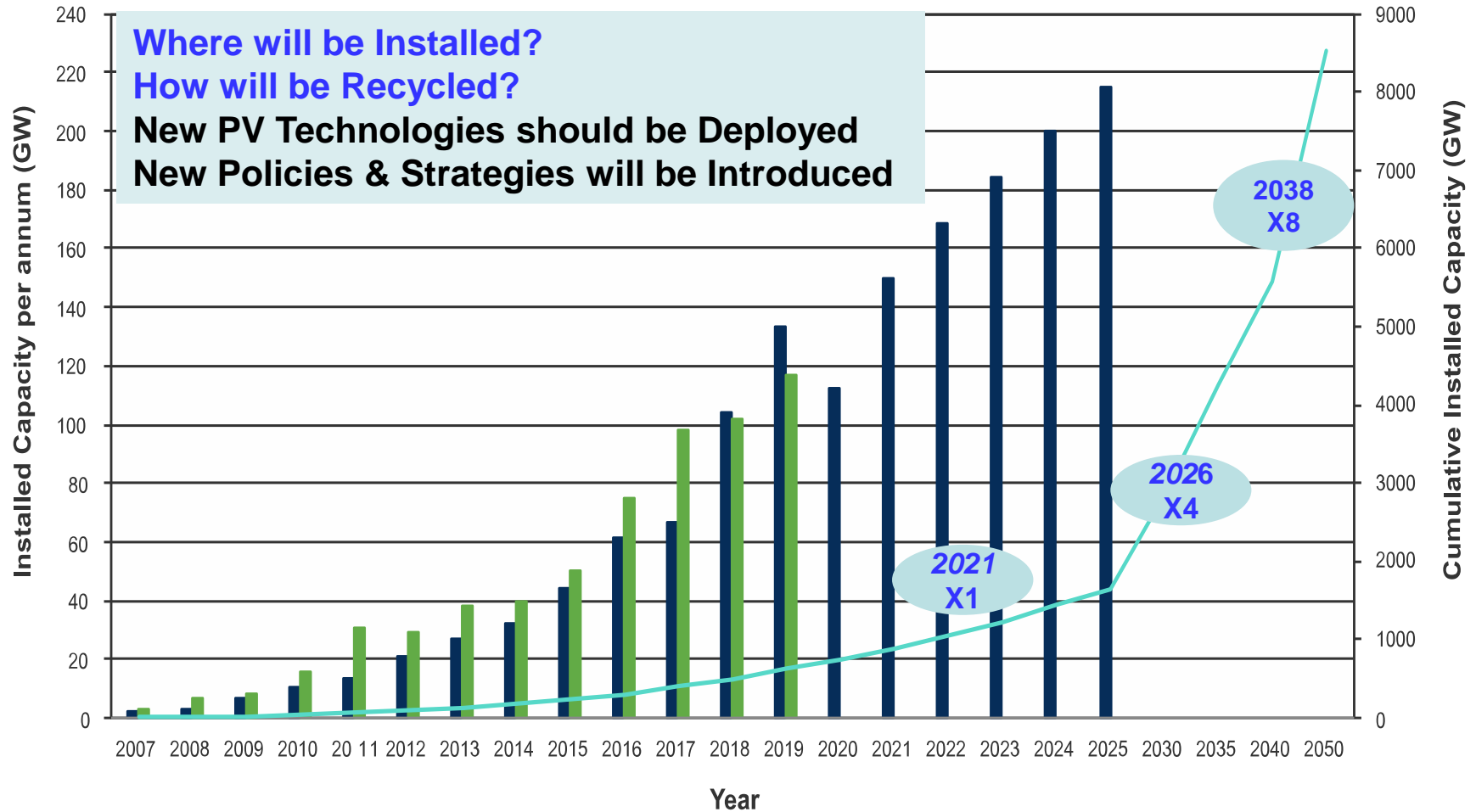
## BIPV Market Forecast 2020-2028



# Global Solar PV Installation: 280GW in 2023, 5000GW in 2035!

**PV Installation: 280GW/2023 (1 Unit Land)**

**5TW/2035 (18 Unit Land), >75TW/2050 (>250 Unit Land)**



Expected Installed Capacity    Actual Installed Capacity    Cumulative Installed Capacity

# Organic Electronic Technologies (OET)



[oe-technologies.com](http://oe-technologies.com)



**World leader in R2R Manufacturing and Technologies for OPVs and OLEDs**

**Holds >32 Years' experience in Thin Film Technologies and Organic Photovoltaics**





# Nanotechnology Lab LTFN... to COPE-Nano Center of Excellence

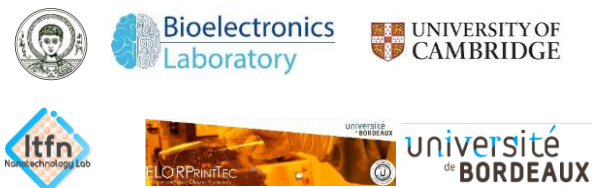
## Centre of Excellence for Organic, Printed Electronics & Nanotechnologies (COPE-Nano)

Teaming for Excellence (HORIZON-WIDERA-2022-ACCESS-01)

2023-2029

Budget: 30 M€

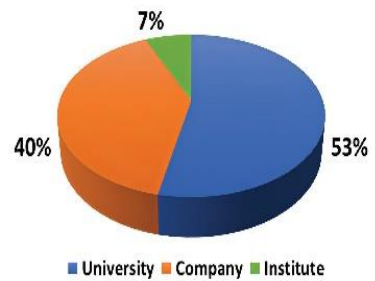
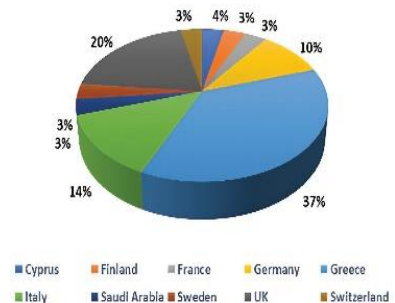
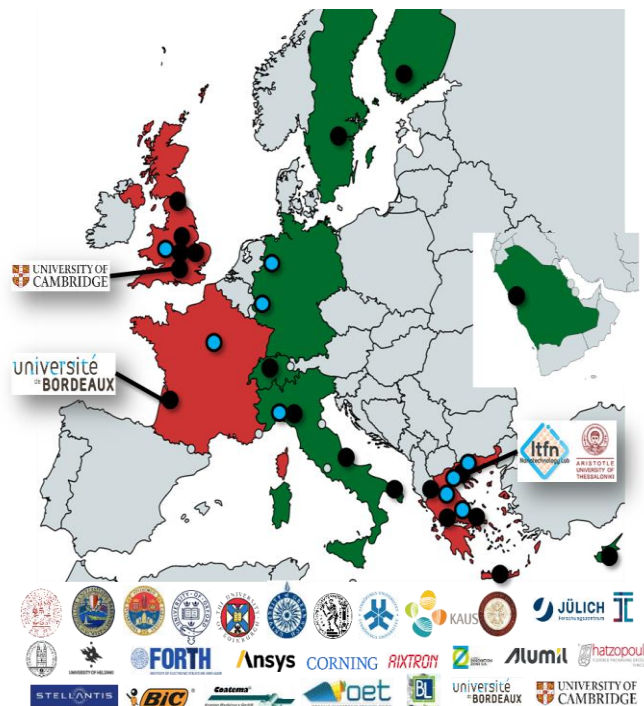
Project Coordinator: Prof. S. Logothetidis  
3 Excellent Partners from 3 EU countries



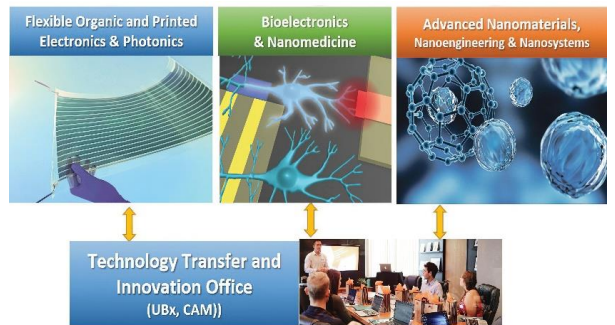
[cope-nano.eu](http://cope-nano.eu)



>5.000 m<sup>2</sup>



### COPE-Nano Institutes



### COPE-Nano Institutes

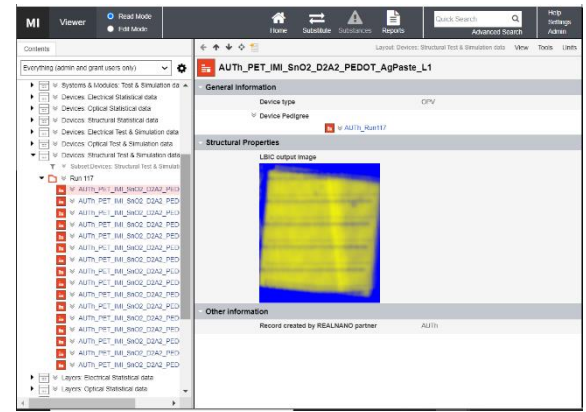
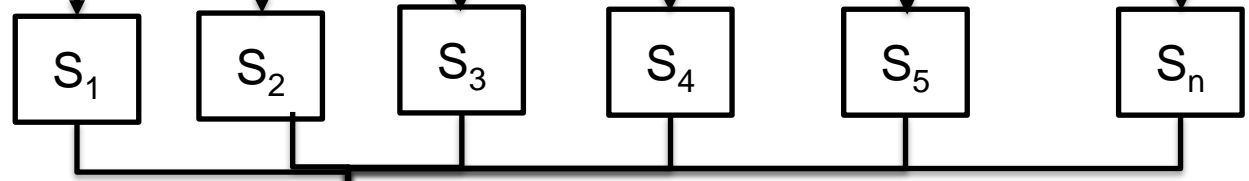
- Flexible Organic and Printed Electronics & Photonics
- Bioelectronics & Nanomedicine
- Advanced Nanomaterials, Nanoengineering/Nanosystems
- Technology Transfer and Innovation Office
- Agro-Nano



# LTFN's and OET's: 100 Collaboration Partners to develop OPVs



# R2R Printing P2P Line with robust Data Management for in-line Sensor Datasets

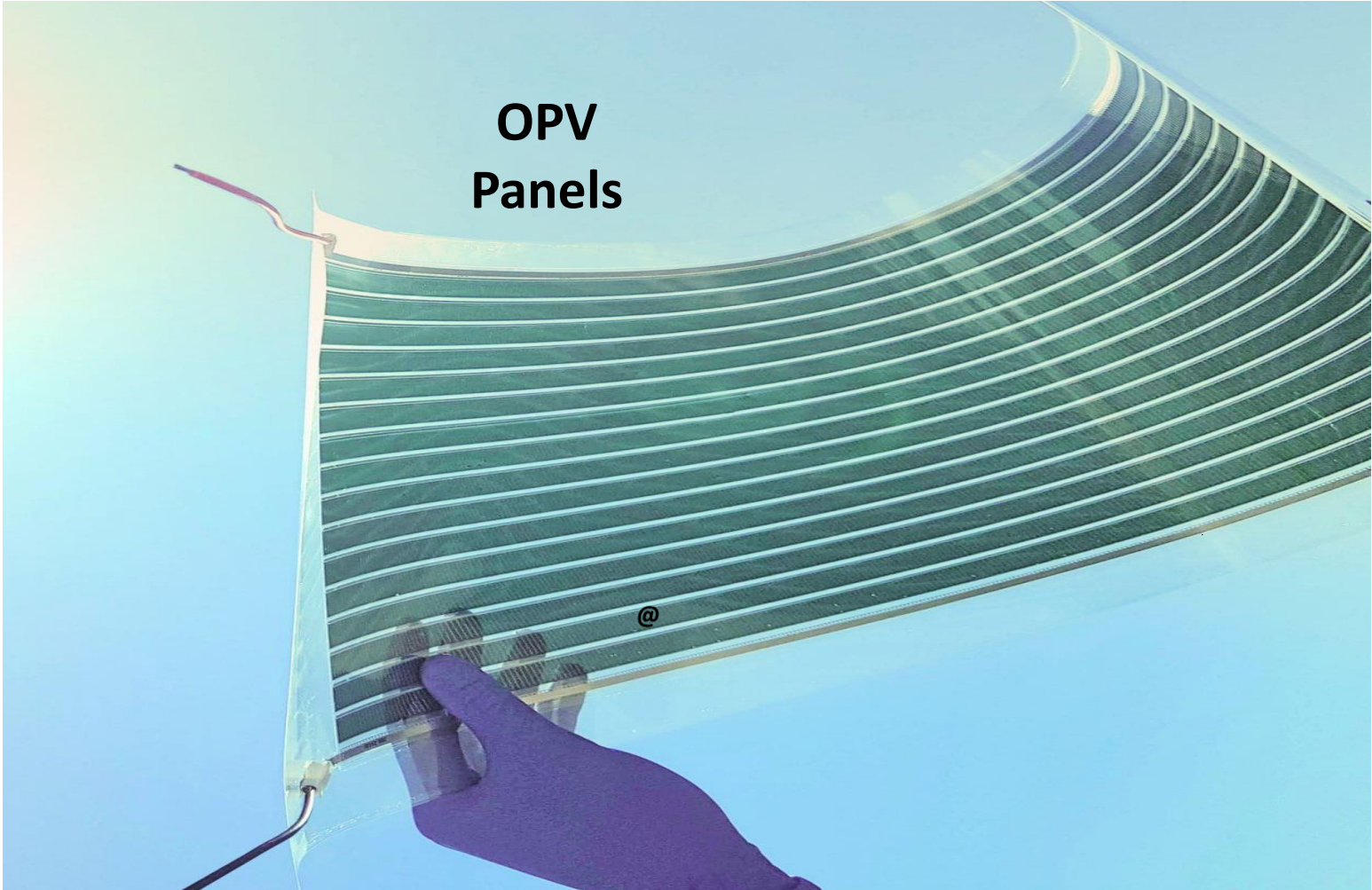


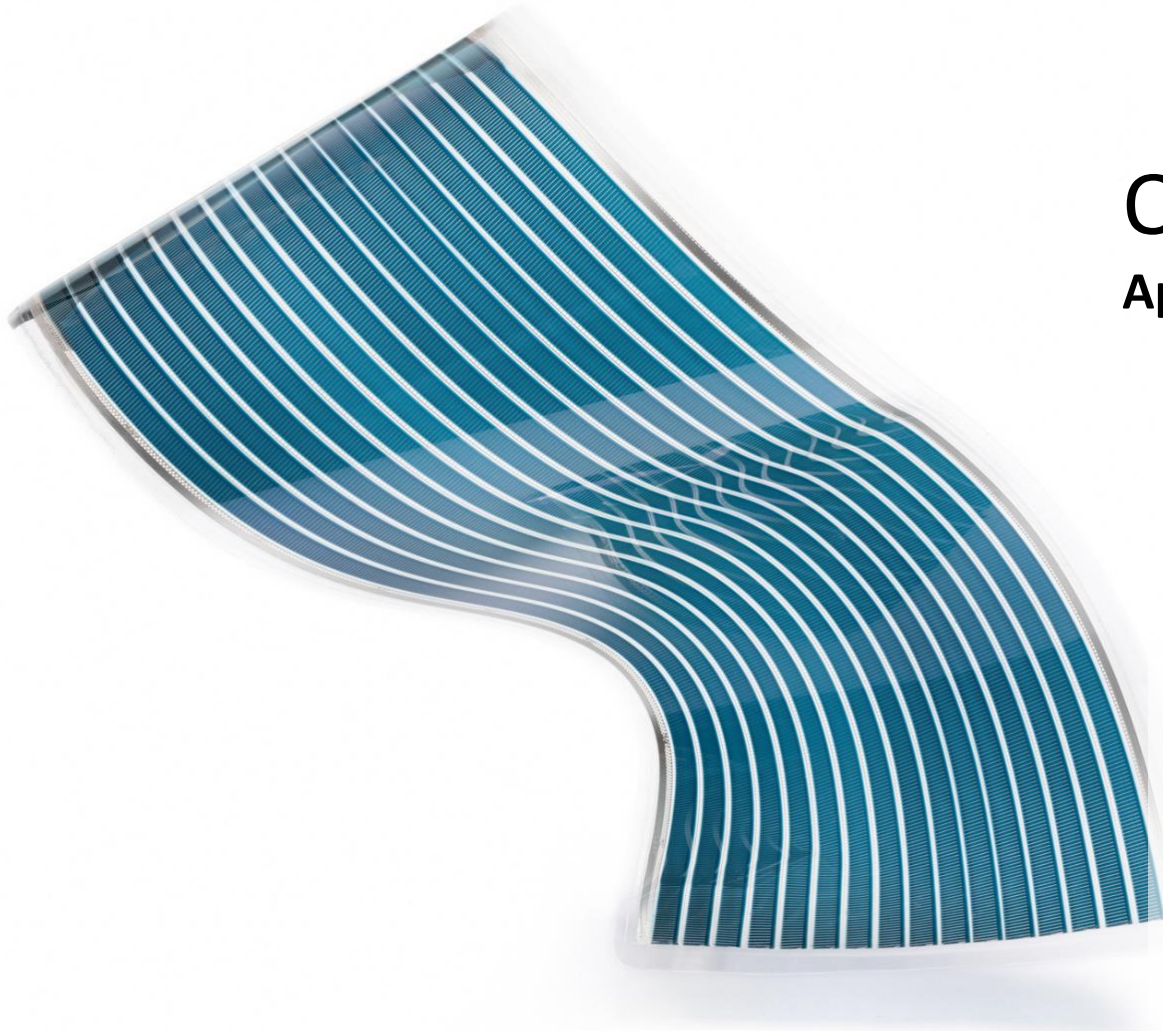
**Metrology Control Platform**

**Data Management System (AI, ML)**



# Reliable Fabrication of OPV Panels





# OET OPVs

## Apollo series

- Large Area in Custom Shapes and Sizes
- Flexible & Rollable
- Lightweight ( $\sim 0.5 \text{ kg/m}^2$ )
- Transparency  $> 40\%$
- Aesthetic Design
- Variety of Colours
- Ideal for Indoor & Low Light Applications





# New OPV Product

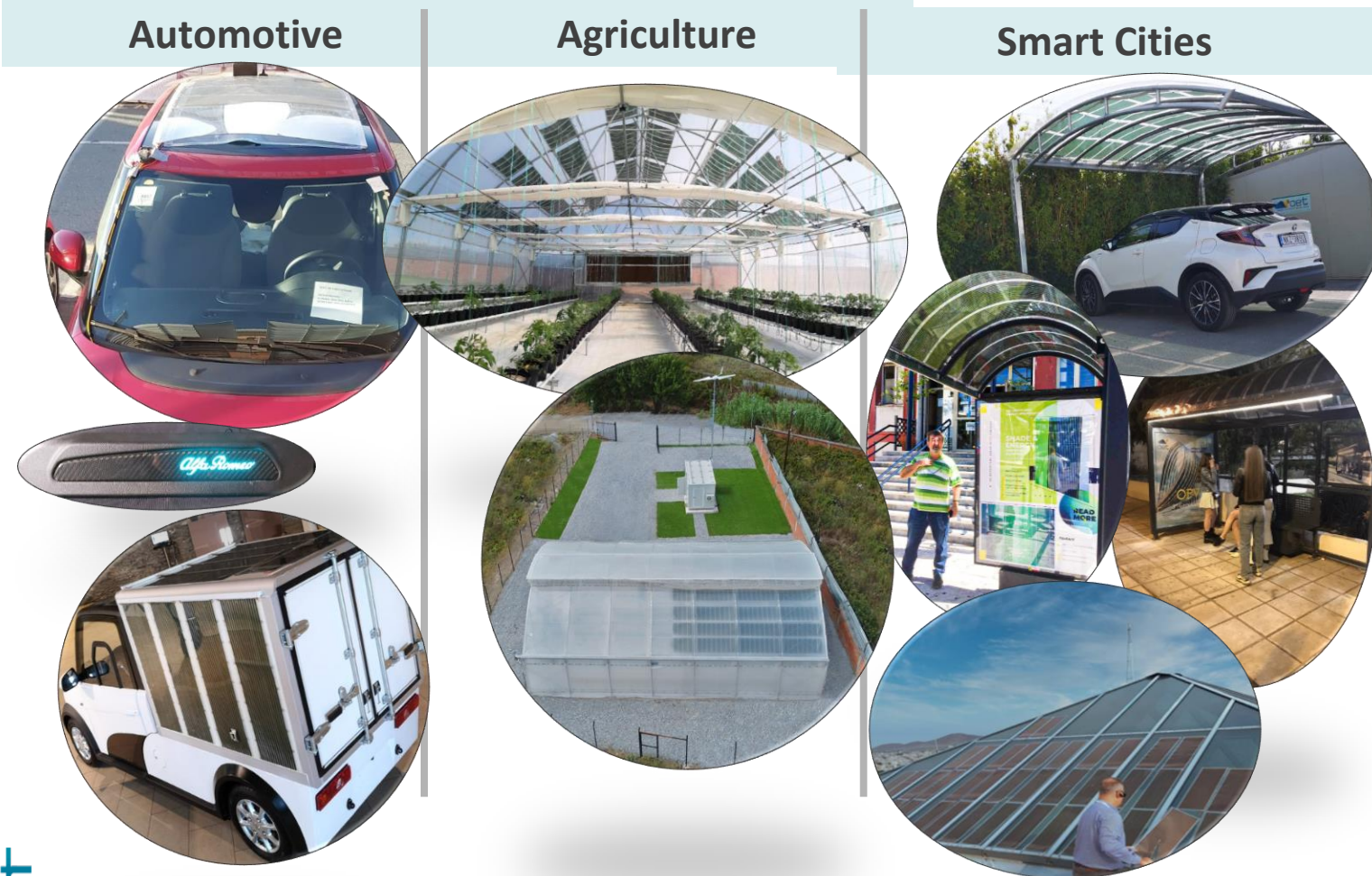
## Futura Series

- Homogeneity
- High Visual Uniformity
- High Transparency >50%
- Ideal for Building Applications
- Freedom of Design



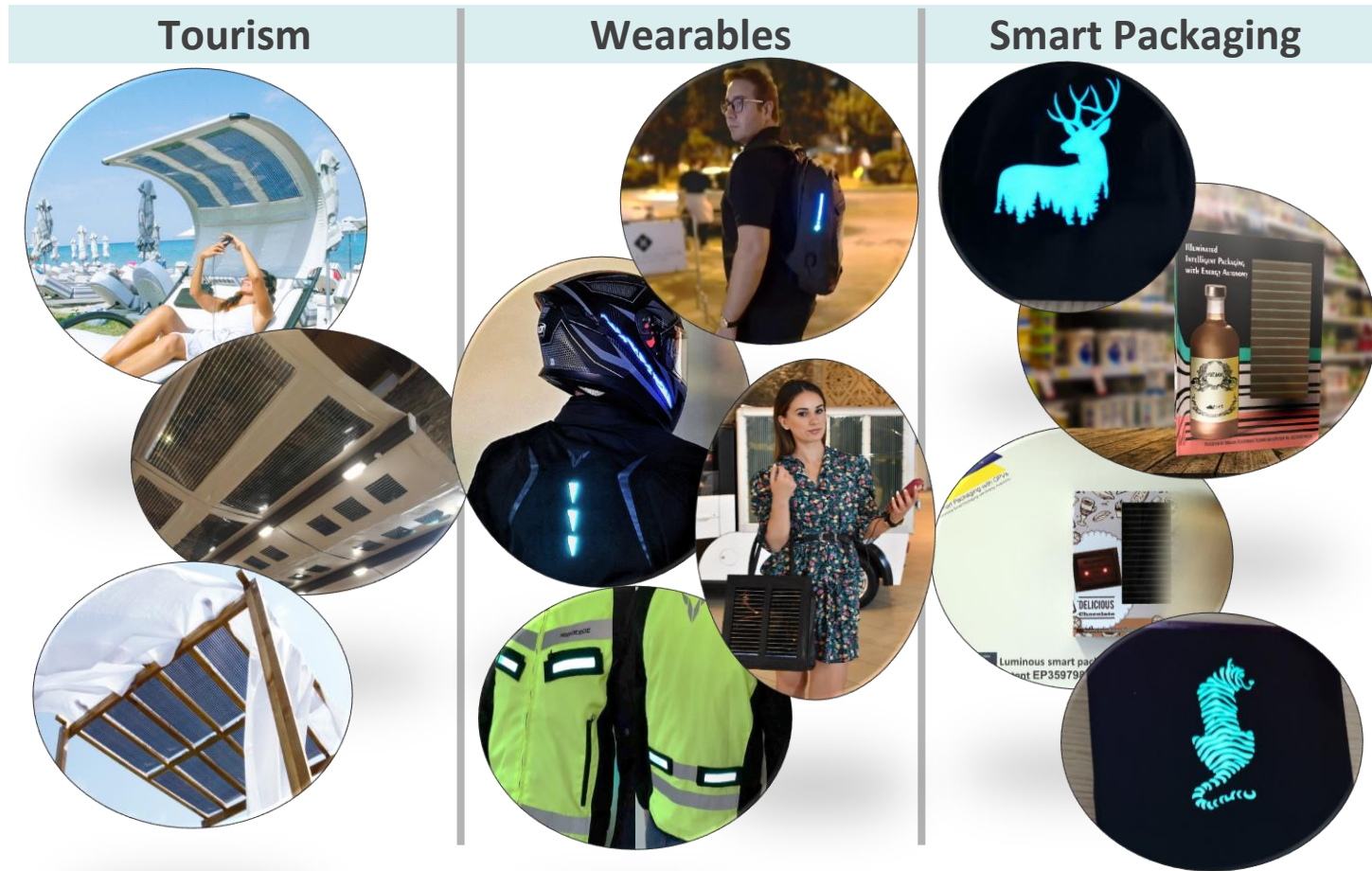
# OET's OPVs and OLEDs Products and Applications

## Energy and Lighting from any Surface - Everywhere



# OET's OPVs, OLEDs Products and Applications

## Green Technologies Combined with Luxury and Aesthetics





# Building Integrated PV (BIPV): Energy Efficient Window

## The Idea

is a Building Integrated PV solution with high Transparency, high Efficiency and uniform Design (Aesthetics).

**The Customer Concern** is related to the use of RES that can be integrated in **Windows, Facades, Curtain Wall, and Skylights** because existing solutions change the Architectural Aesthetics and Functionality of the Buildings. In addition, most existing Solutions lack in Efficiency.

**The Energy Window:** OET has implemented the **OPV Panel Gen2** with High Transparent and Uniform Membrane. The Panel is most suitable and attractive for the Buildings with **unique Aesthetics Design, Outstanding Performance & Payback Period.**



Gen1

OET Energy Efficient Window



Gen2



# Building Integrated OPVs: Energy Positive Buildings

**OPV  
window  
(Gen 2)**



**OPV  
window  
(Gen 1)**



**Glass  
window**



# Smart Bus Station



## OET's OPV Smart Bus Station

### OPV Retrofit

- Charging Station for Smartphones
- Advertising Space with OLED light powered by OET OPV
- 4G Wifi router powered by OET OPV
- Lights powered by OET OPV
- 100% Solar autonomy Energy powered by OET OPV

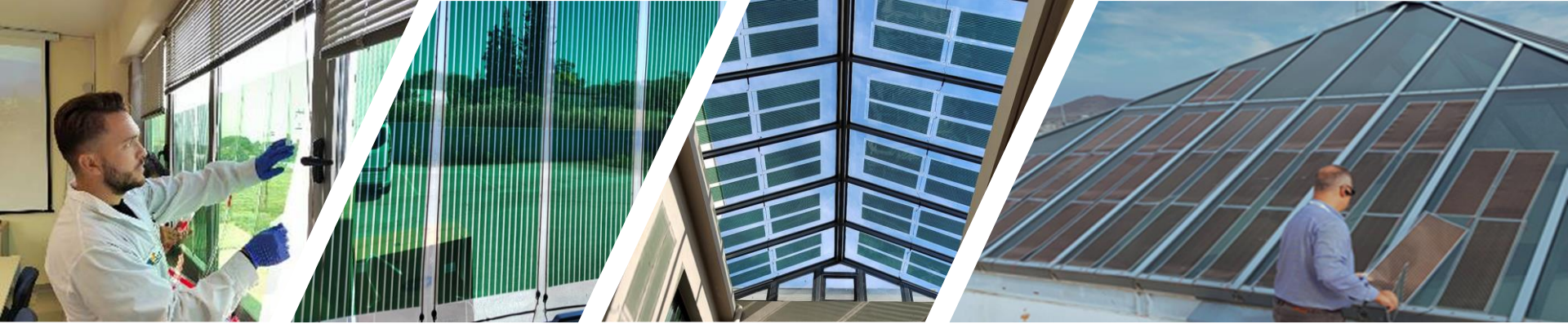


# OET's OPV Real Case Projects

## BIOPVs

Is a Market able to provide an Aesthetic Window Film in addition to other alternatives and Designs to reduce a Building's Energy Usage





# BI(O)PV

- Building Integrated Organic Photovoltaics

## Energy System

OPV films are suitable for all Designs and Surfaces made of light and flexible materials



# Infrastructure IPVs

Infrastructure Integrated Organic Photovoltaics



# OET's OPV Real Case Projects

## Solar Energy Window

Embedded final Solution with High Transparency and Energy Harvesting

## World's first automated R2R Manufacturing Line for Integrated Organic Photovoltaics



- **Work programme:** HORIZON-CL5 2022-D3-01-03
- **Duration:** 48 Months (01/2023 – 12/2026)
- **Total Budget:** 21,116,625 Euros





# F2E: Manufacturing a Production Line for million m2



Ultra Fast Laser Patterning

Digital Mechanical & Laser Cutting



In-line Real Time Integrated Quality Control



4-axis Complete Automated Slot-die Coating



R2R Printing Machine

4. Industry

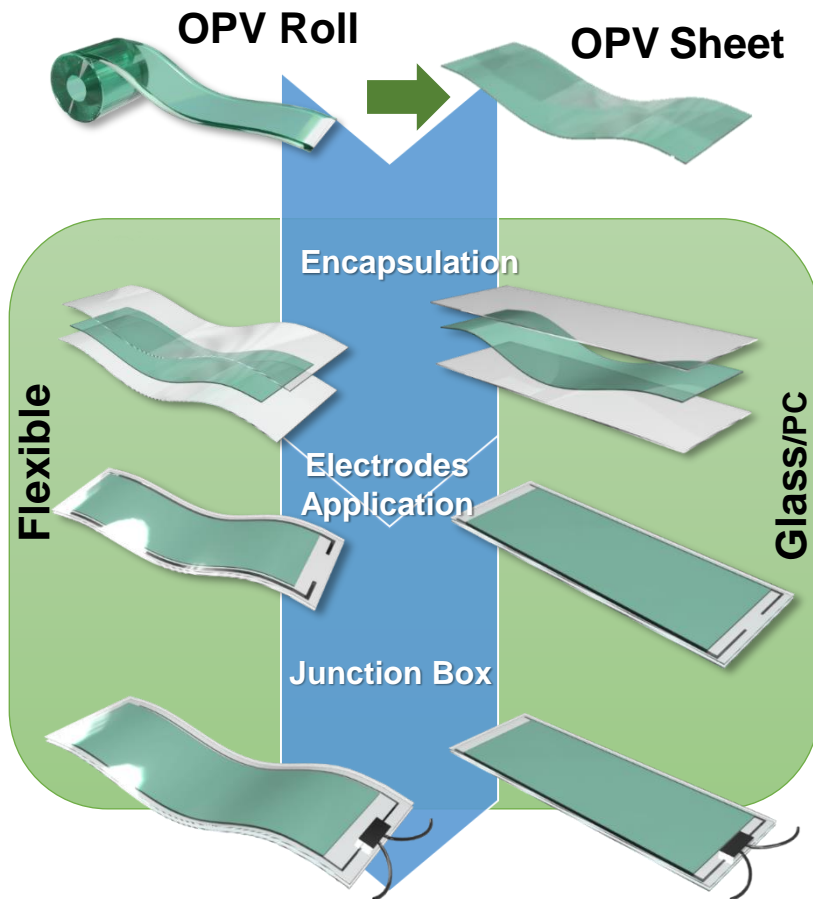
Automated Assembly Machine

Robotic Handling  
Digital Processing  
High Accuracy monitoring  
Automated Assembly

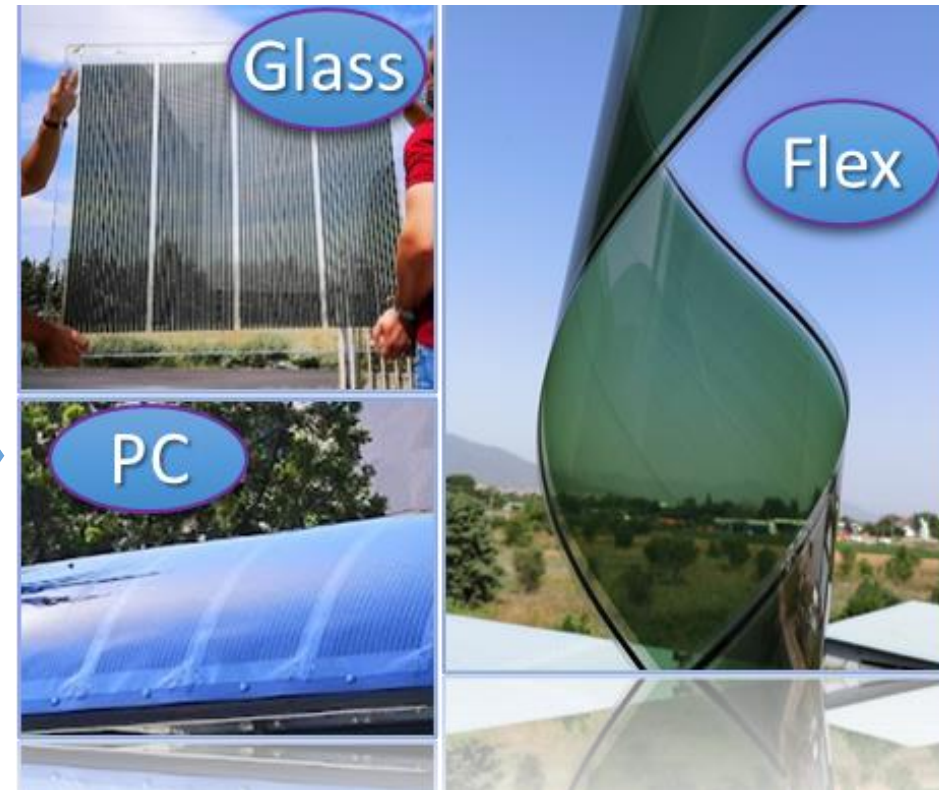


# Integrated PVs (IPVs) Products

- From Nanomaterial inks to **Rolls of Flexible Transparent OPVs**
- From Rolls to **ready to use IPVs** with **unique Design, Aesthetic & Performance**



## Final IPV Products



# F2E Manufacturing Production Line Concept



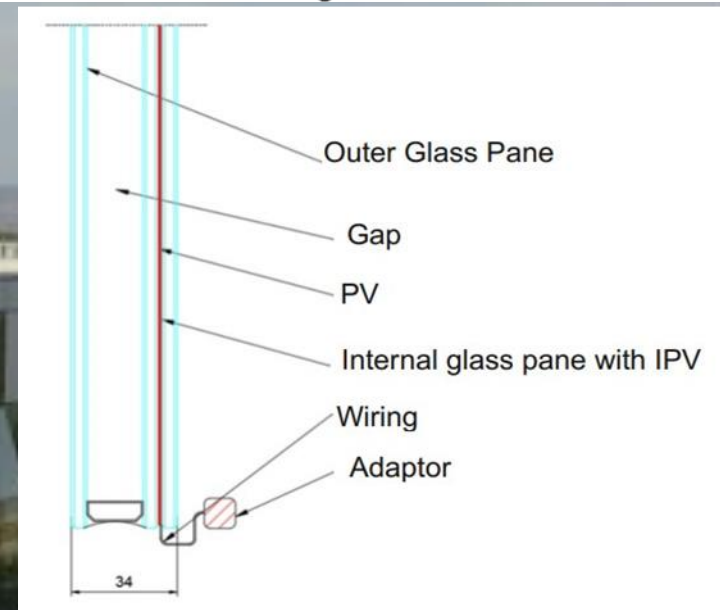
# Flex2Energy Demonstrators

## BIOPVs – Building Integrated Photovoltaics



- **BIPV Products on the Façade of Alumil's Industrial Building (Greece)**

Indicative Design of the glass pane with integrated OPV

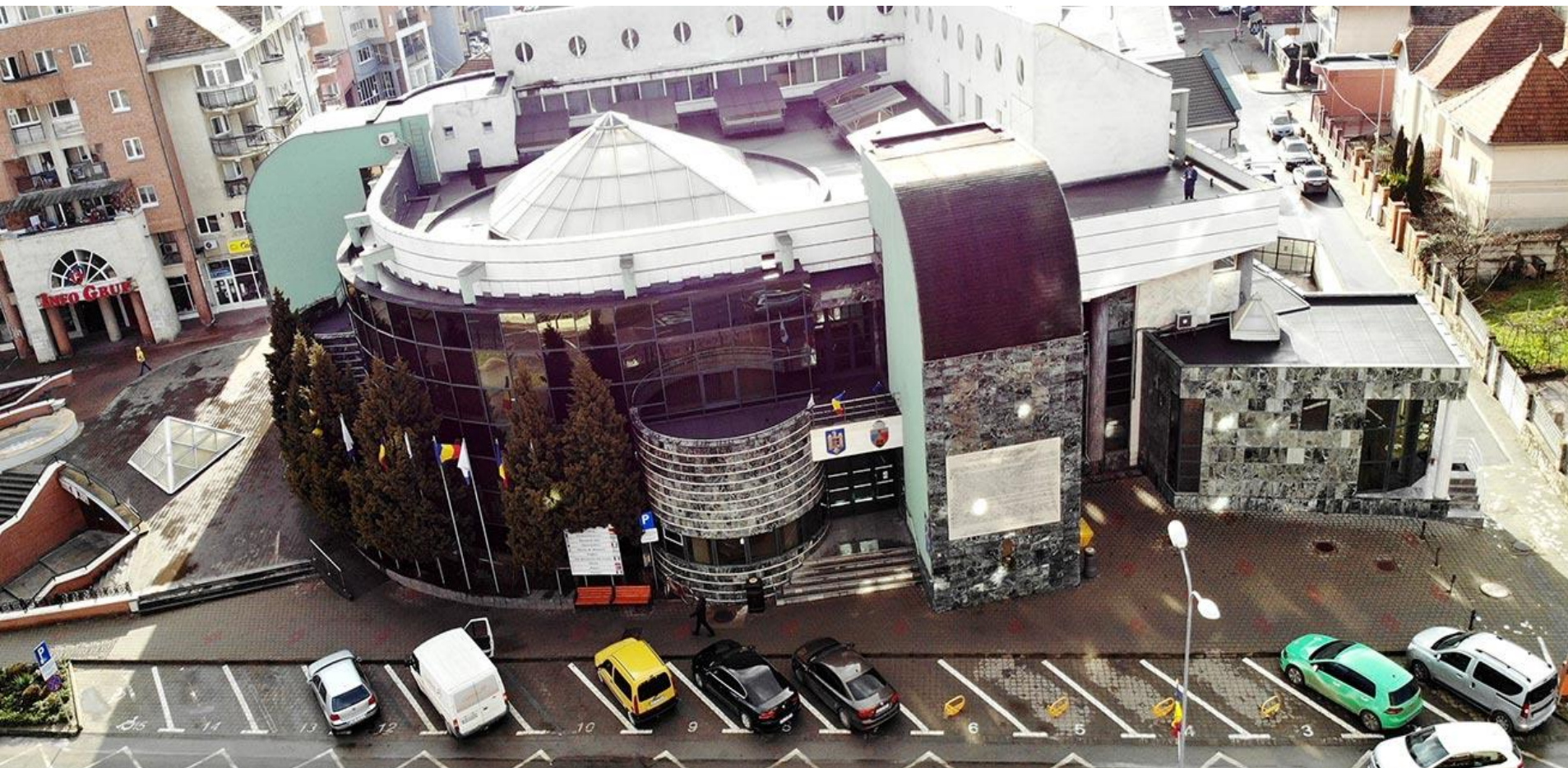


# Flex2Energy Demonstrators

## BIOPVs – Building Integrated Photovoltaics



- BIPVs Products on the Glass Façade of Alba Iulia Municipality Building (Romania)



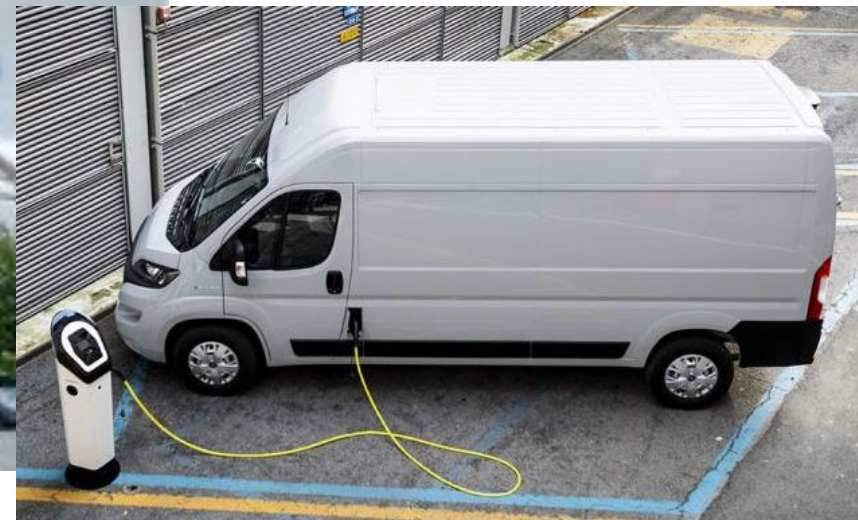
# Flex2Energy Demonstrators

## VIPVs – Vehicle Integrated Photovoltaics

(2 Demonstrators, Italy & Greece)

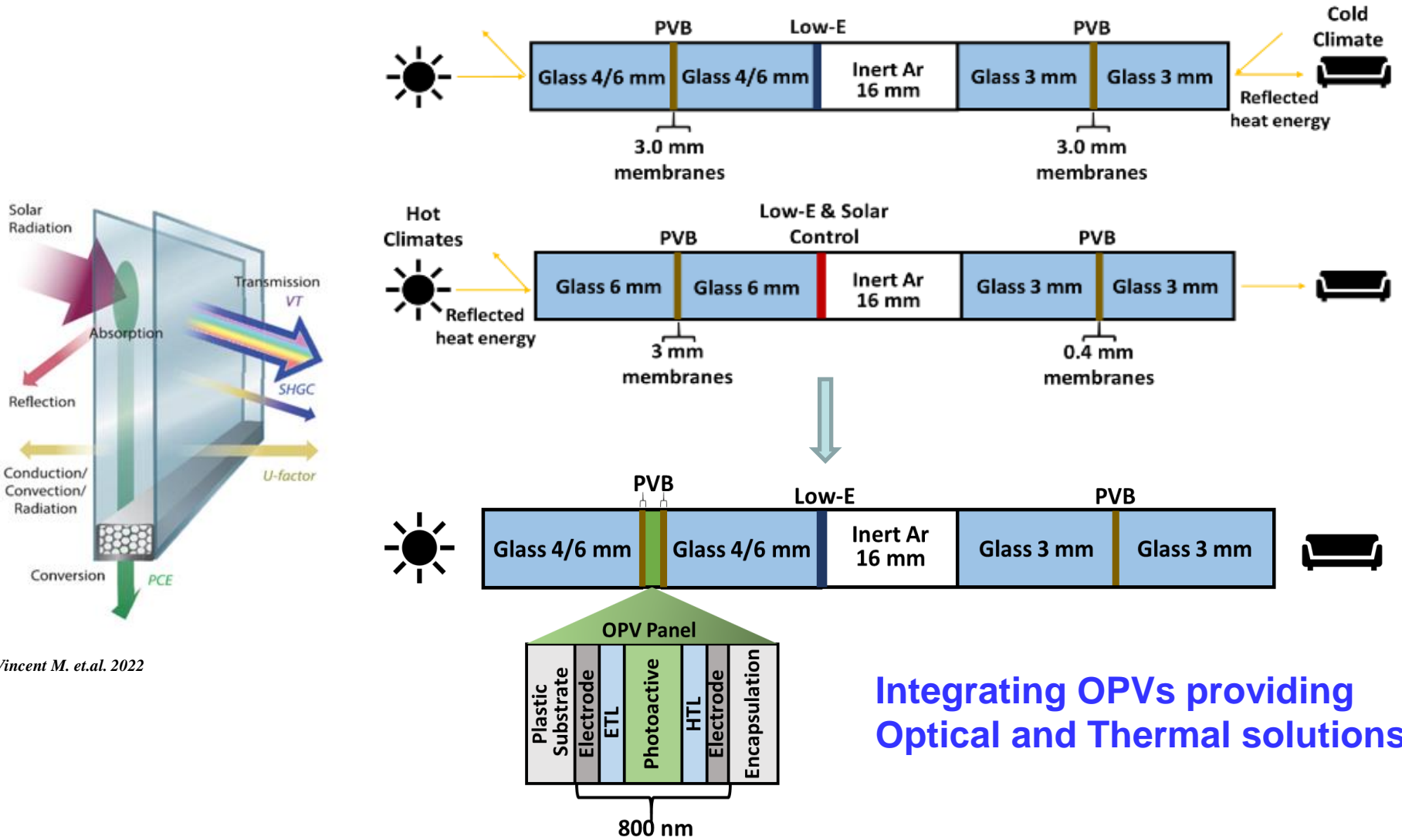


- **VIPVs will be installed on FIAT/STELLANTIS Ducato Electric Vehicle**
- **IPV Products on a Carport Providing EV Charging Spots**



# Optical and Thermal control solutions for smart Energy Positive Buildings

## Multi-scale optical engineering in an insulating glazing unit for Energy Building



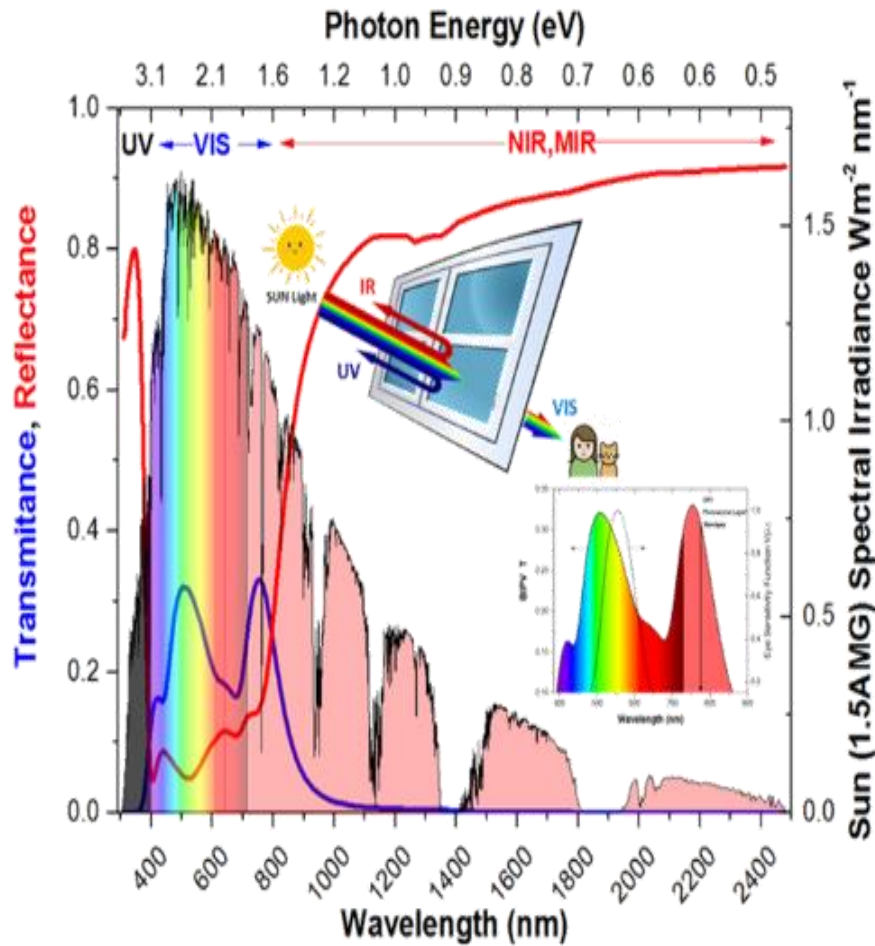
Vincent M. et.al. 2022

Integrating OPVs providing Optical and Thermal solutions

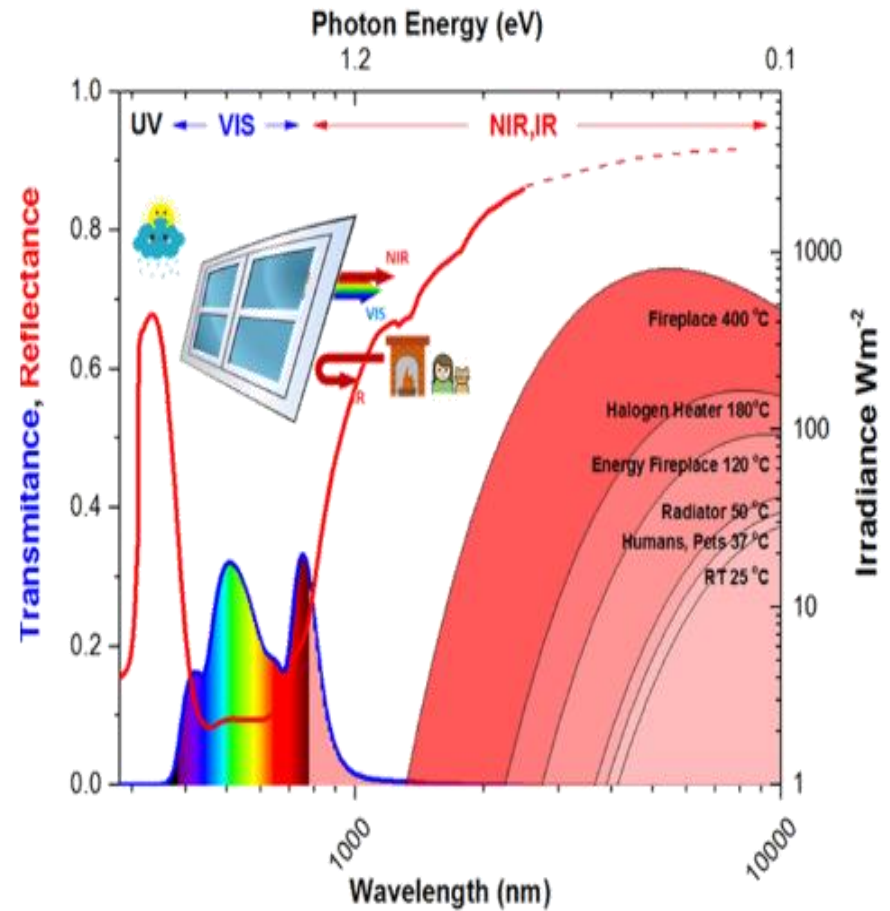
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# Optical and Thermal control solutions for smart Energy Positive Buildings

Tailoring Transmittance & Reflectance of Solar/Heat based on Climate conditions maintaining the PV function by Multi-scale Optical Engineering strategies



a) Outdoor to indoor



b) Indoor to outdoor

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# Thank You!

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